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TABLE OF CONTENTS

The Dial Office "Cutover"
A. E. VanHagan

Seven Billion Toll Rates

Long Toll Cable Construction and Maintenance
L. N. Stoskopf

An Index of General Business Activity
P. J. Weber

Standardization in the Bell System—II
H. S. Osborne

Abstracts of Recent Technical Papers from Bell System Sources

Notes on Recent Occurrences

Organization Changes

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The Dial Office "Cutover"

SINCE the advent of dial service in the Bell System, a new word is coming more and more into use. It is " Cutover." Its use is not confined to telephone workers. Telephone users, whose service has been changed from manual to dial, have encountered the word and have used it. More than 3,100,000, or 21.7 percent of the Bell owned stations, were served by central office equipment of the dial type at the end of 1928, and for more than 2,000,000 of these there was a transfer from manual to dial service. A great many people by this time know the word " Cutover " and the change in service associated with it.

What is a " Cutover " ? In instances where the Bell System has acquired a dial plant with a numbering plan inadequate for the entire service in the city, the cutover has involved an expansion of the numbering plan so as to comprehend service to all the telephones in the city, the introduction of an additional train of switches in a working plant, and an increase in the number of pulls of the dial necessary to call a number. In general, however, a cutover involves the transfer of part or all of the subscribers in a given manual office to a

new dial office. The dial equipment may be in the same building with the manual, or it may be in a new building a block or even a mile away.

To the layman, perhaps the most impressive type of cutover is the one that involves a transfer of the service from one building to another. It is mystifying to understand how the thousands of lines involved may be working in a manual office until nearly midnight on the day of the cut and at midnight they are all working in the new office with each line in its proper place. "How long does it take?" "How is it done?" "Are the lines cut off from service altogether?" "Isn't it very dramatic?" These are some of the questions that are asked.

Does a cutover have any drama? For the casual observer, no. It is not physically possible to watch all the steps involved in making a given cut. The time intervals between steps are too short to allow one to travel from point to point. Even actual observation of each step would not be sufficient, for it would be necessary for the mind to build up a picture of what each step signified.

But to the men and women engaged in the work, there is all the thrill that a First Night at the theatre has for the cast—and more. Actors rehearse for a few weeks, but the telephone operating forces have been in training for months, and work on the job has been in progress for a year or two. If actors fail to provide entertainment, they seek another vehicle for their efforts. But the principals in a telephone cutover cannot fail, and their audience—the telephone users—is the most critical in the the world. Their mistakes would disturb a service that is essential to the community. They have been rehearsed in each step in the cutover program. They have their cues. They all know that the success of the job requires that each one perform his or her allotted task at the assigned time. Pride of

craft requires that each one will not be found wanting. Indeed there is drama—plenty of it.

Preparatory Work

Suppose we consider some of the major steps leading up to the cut, and then, eliminating time and distance, attend all points of interest. For example, an old manual equipment in an old building is to be replaced with dial equipment in a new building some blocks from the old one. A sufficient amount of equipment is engineered and ordered to care for the growth in that area for two years from the date when the new office goes into service. The new building is started and both telephone people and customers, located in that area, are interested in watching it grow. The operations are so timed that by the time the building is finished, the equipment is delivered and the installers are at work.

While this work is in progress, the Plant forces are busy building the underground conduit and installing cables so that the subscribers' lines and the inter-office trunks may be connected to the new office. In due time each subscriber's line served by the old office is spliced to a cable pair leading to the new office. This is all done before the cutover takes place. Steps are taken to be sure that each line is in its proper place in the new office before it is cut from the old.

While these steps are in progress, many others are under way, all of them being timed so that they are completed at the proper date with reference to the cutover. The various private branch exchange boards must be replaced with new boards that will work properly with the new dial equipment. Along with these changes, it is frequently necessary to change the night service arrangements required by the subscriber, these changes involving both equipment and directory listings.

The Plant forces must replace all the manual instruments in the area with dial instruments, and must assure themselves that it is possible to dial satisfactorily from each instrument over the subscriber's primary loop to the central office. If a given line is found to be unsatisfactory, the condition must be corrected. Nothing is left to chance. By the time the cutover occurs, there must be assurance that each telephone is connected to the assigned terminal in the office, and that it is possible to dial from that telephone over the subscriber's line into dial equipment that will work in accordance with design.

Several months before the new office is cut into service, the traffic engineers must complete the work of assigning each line to the proper terminals in the new office so that adequate provision is made for the normal calls from and to each subscriber. This involves a study of the requirements for each class of subscribers as well as individual assignments for each subscriber. This work involves many number changes but no unnecessary ones are made. Where number changes are necessary, steps are taken to make them so as to cause the minimum inconvenience to the subscribers affected.

The Plant men who must cut over the new office and maintain it receive their training for several months preceding the cut. As the new dial office requires operators to handle toll calls to nearby towns, to assist customers who have had difficulty, and to handle calls for numbers that have been changed or discontinued, it is necessary to train some of the manual operators in the duties they will have to perform when the new equipment is cut into service. This work is in progress for several weeks preceding the cutover.

Of course the change from manual to dial service makes it necessary for the customer to understand the new method of placing his call and the day, hour, and minute when this change becomes effective. This work of public instruction is carefully planned and executed.

In a good many cases it involves a visit to the premises of each subscriber and a thorough explanation of the method of dialing. The work is not considered complete until the subscriber has actually dialed some practice calls under the supervision of a telephone representative.

Shortly before the cutover takes place, the Plant forces conduct a series of tests from the multiple in the old office to the terminals in the new office to make sure that each subscriber is actually connected to the terminal in the new office to which he has been assigned.

The above paragraphs do not cover all the steps involved in a specific cutover but perhaps they will give an idea of the many important activities under way and the thought that is given to the responsibility of co-ordinating all of them so as to complete them neither too early nor too late.

Transfer of Trunks

As the day of the cutover arrives, there is an undercurrent of tenseness that cannot be wholly concealed by the smiles with which the men and women on the job greet the visitor. A visit to the old manual office is interesting. The operators are busy, but they seem to handle the old equipment tenderly. Some of them are tearful. Subscribers have called up to say good-bye, to apologize for cross words, and to express thanks for good service. A supervisor smiles a greeting with glistening eyes. The chief operator tells what the service index is for the month to date, and it is evident that she did not let the service slump even though her force was to be scattered. She tells of the good-bye party that was held the evening before and admits that most of the operators cried over the breaking up of old associations. All welcome the new but there is a little pang at parting from the old.

Over in the new office there are some cutover activities under way on Saturday afternoon. The inter-

office trunk plant is gradually being transferred from the old office to the new as the traffic lightens. On previous Saturdays, records were taken of the way the traffic declines on a Saturday afternoon and evening, and estimates have been made of the number of trunks in each group that may be released each half hour, beginning about twelve noon. The Traffic and Plant men have agreed not only as to the number of trunks in each group that may be released at each interval but have selected the specific trunks. These trunks are listed. Traffic men in each office arrange to put them out of service a few minutes before they are scheduled to be cut. These operations are co-ordinated by a Traffic Dispatcher at a Private Branch Exchange section located alongside another one which is used by the Plant Dispatcher. When the Traffic Dispatcher has received an O.K. from each office on the trunks to be released at a given time, he clears with the Plant Dispatcher who gives the Plant men at each office orders to proceed with the scheduled operations. This process goes on all afternoon and evening up to eleven o'clock, by which time about ninety percent of the trunks have been cut to the new office without creating any trunk shortage in the old office.

The casual visitor would be little interested in this work. There is nothing spectacular about it. A word or two from the Dispatchers to each office is sufficient. And yet real happiness shows in the faces of the men who have planned and executed this work when they have completed the transfer of an ample supply of trunks to the new office without holding up a single call to or from the old office because of a trunk shortage. For them the day is full of drama. Loss of sleep and even serious illness are not sufficient to keep them from executing the plans that they have set up. Pride of craft is indeed strong among telephone men and women.

The Cutover

The first cutover in a given city is usually scheduled for midnight on a Saturday. The traffic is light at that hour. There is little use of business telephones on Sunday, thus widening the margin for curiosity calls from residence customers. The Plant and the Traffic forces need Sunday to be sure that everything is running smoothly and is in readiness for a heavy load on Monday. Then too there is little possibility that some telephone users will confuse midnight with some other hour.

As the hour of the cut draws near, there is evidence of something unusual at both the old and the new buildings. Many cars are parked before both buildings. Lights shine through all the windows. A visit to the old operating room shows the usual night force at the board for handling the usual light Saturday night traffic. But one notices that every operator is dressed in her "Sunday best." Most of them never had any experience with a cutover and they are not sure about the attendant ceremonies, but, whatever happens, they wanted to be dressed for it. They are a little excited, and when at eleven fifty, they get word to start a scheduled step in the cut, their voices tremble as they cut in on each talking connection and advise the customers that "We are about to cut over the new dial office." The same information is given on new calls. If an emergency call is encountered, steps have been taken to handle it at the new office if it is interrupted by the cut.

At the main frame downstairs, men are stationed at close intervals. Cords run behind the heat coils. At a word over the telephone from the Dispatcher, the man in charge signals his lieutenants who in turn pass the word to the men to "Pull. Take it easy." As each man takes hold of the cord at the bottom of the bay and pulls, a barrage of heat coils comes flying from the

frame. Goggles or a visor protect the eyes of each man.

Of all the cutover operations, this one is perhaps the most spectacular to the casual visitor. It is of even greater interest to the men. In all the years that they have worked in that office, their problem has been to maintain service, but with a rip they have torn out all the heat coils and there are no subscribers connected with that office. When telephone men do a job so foreign to their regular work of maintaining the service, it bespeaks their confidence in the soundness of the plans that have been set up. The operation is over in thirty seconds. The man in charge reports completion to the Dispatcher.

This particular cut involves the severing of certain cables in the cable vault at the old building. The quarters there are crowded but the men who are to do the cutting are lined up outside, each man equipped with a small ax. In a few moments they will be required to perform an unusual task. Their job has been to install and to maintain those cables. In a moment they will take an ax to them. On signal they file into the vault and take positions to which they have been assigned. The name of each man appears at his post. The cables he is to cut have already had the sheathing removed, and all is in readiness. The man in charge receives the order from the Dispatcher, and quietly orders the men to cut. Quickly the job is done. The cable ends are fanned out so that short circuits will not be created by this operation. In a few seconds a completion report is passed to the Dispatcher.

At the new office, it is necessary to show credentials in order to enter. There are signs of activity on every floor. A trip to the basement is worth while, to inspect the new power plant and the long, straight runs of cable in the new cable vault. The contrasts with conditions in the old office are as marked here as in other parts of the building.

And now let us visit the new operating room a little before midnight. The small switchboard seems inadequate to an observer fresh from an inspection of the old one. The flowers on the Chief Operator's desk and the many visitors are evidence that something is about to happen. At a few minutes before twelve the operators file in and take their places at the board. Like those in the old office, they have dressed especially for the occasion. They, too, are somewhat tense. They have had weeks of training for their new duties. In a few minutes the curtain will rise on a new performance. Each operator wonders what type of call she will first encounter and each wants to be sure that she does the right thing on that call. Though their tenseness may be unobserved and their emotions may be unknown to the casual observer, telephone people understand. In a few minutes some lamps at the board will light. Hands may tremble a little—it will be like a "first night." But the confidence will come at once. The operators will be ready. They always are.

At the line finder frames in the new Switch Room, small insulating wedges were inserted in the cut-off relays a few days before the cutover, so that the equipment in the new office would not be affected by any calls that the subscriber might originate so long as the old office was in service. Each of these small wedges has a hole in it, and groups of them are strung together. A few minutes before midnight, a group of men file in and take their places before these frames. The man in charge is at the telephone. His lieutenants stand at the end of each row of frames where they can see him and also see their men. At the scheduled time, the signal from the Dispatcher is relayed to the men at each frame. They quietly pull the cords, removing the wedges. Midnight strikes. The new office is in service, and the switches begin to move as telephone users dial their calls. An office has been cut over.

As a part of the over-all picture of every cutover

there are, for those who look for them, little close-ups that give a human touch to what may seem to the casual observer merely a matter of routine. A certain cutover, for example, involved the advance delivery of a new directory, accompanied by a request that the old directory be used until midnight of the day of the cutting in of the new equipment, and that the new one be used thereafter. The subscribers had been asked to destroy the old directory and the transmitter card as soon as possible after midnight. One of them dialed " Operator " a minute after midnight to make the following report of his share in the success of the cutover: " I burn up my old directory. I tear up the card on my telephone. I use my new directory. I done everything you told me to. All right to go to bed now? "

Gratefully, he is assured that his part of the job is done. Gratefully, because such calls are evidence of a desire on the part of the public to co-operate with the telephone people in making service go smoothly. Such calls are by no means exceptional. One or more cases of this sort are encountered in almost every directory cut.

The Center of Cutover Activities

Let us enter the new terminal room on the night of a cutover. Near the Dispatcher's desk is a knot of men, talking quietly to each other. They are the men who have been intimately concerned with planning for the cutover and in the preliminary preparations for what is about to take place. Curiously proud of their part of the job, they are—yet curiously generous in sharing credit with others. The Plant men give us detailed figures that tell of the fine condition of the equipment—and then modestly attribute this to the good work done by the Western Electric Company installers. The Installation foreman tells his story of the job of getting this enormous amount of apparatus in place—but gives credit for his good record to the fine condition

of the equipment received from the factory. And so it goes, each man with a wholesome pride in his own work, but a pride that sees his work in its true proportions and as related to the work of others. All are right. As we talk with them, we begin to see this job, not as just a Division job or a Company job, but as a System job.

We wander over to the Dispatcher's desk. A lamp lights. He plugs in, speaks a word or two, and disconnects. He notes something on a sheet, plugs into another line, speaks a word or two, and disconnects, again with an entry on his sheet of paper. Many times this is repeated—until the observer begins to think of it as merely humdrum routine. Surely there is nothing dramatic in this plugging into jacks and scratching of notes on a form report.

And yet to the Dispatcher and his men about him who have been planning the job, there is in all this something extremely fascinating. These men know every step of the program. They know what work must be done at each point, how it must be done, who will do it, and when. They visualize the job, as a whole, from its beginning up to its completion, as an architect watches, from foundation to roof, the growth of a building that he has helped to create. Step by step they have done this thing that is about to be finished. They, too, are builders.

The Old Passes

There is drama even in an empty stage, after the curtain has fallen. In the old building, the battery has been cut off the board, the lights have been extinguished, the doors locked. The man who installed that board, twenty-five years ago, was there tonight. Many of the men have worked on that equipment for years. Perhaps they realize that they, too, have been aging with the equipment. Perhaps it is because even machines, when one is long associated with them, assume some-

thing very like a personality. Any one of a dozen explanations will do for the fact that, as they leave the building on this particular night, they joke a little more noisily than usual. There is something a bit like bravado in their cheery "Good-night." But if you were to look at some of them closely, you would see that their eyes were glistening.

Perhaps there is drama in the new building, too. It has been emptied of visitors. Only the telephone people who have been assigned to night duty remain. The building is dark except where there is work to be done.

The casual visitor may have left with the feeling that there was not much of a show, and if he could return and see these people going quietly about their work, he would doubtless think that this scene was still more lacking in the spectacular. Yet, for those who have finished their part of the job, and for these who remain to carry on through the night, there is not a little of romance in this routine thing called a cut over.

They have had a part in a job that has been well done, so far. They will be back Sunday and Monday to be sure that the new office meets the test of a commercial load. They have done a job that measures up to the standards of the System and to their own exacting standards. They will see this job carried on, and neither personal affairs nor lack of sleep, nor bodily weariness, nor even ill health can stop them. You can not make such people, engaged in such a work, believe that their job is a humdrum one.

But unless you can see their job through their eyes, there is nothing dramatic about a cutover.

A. E. Van Hagan.

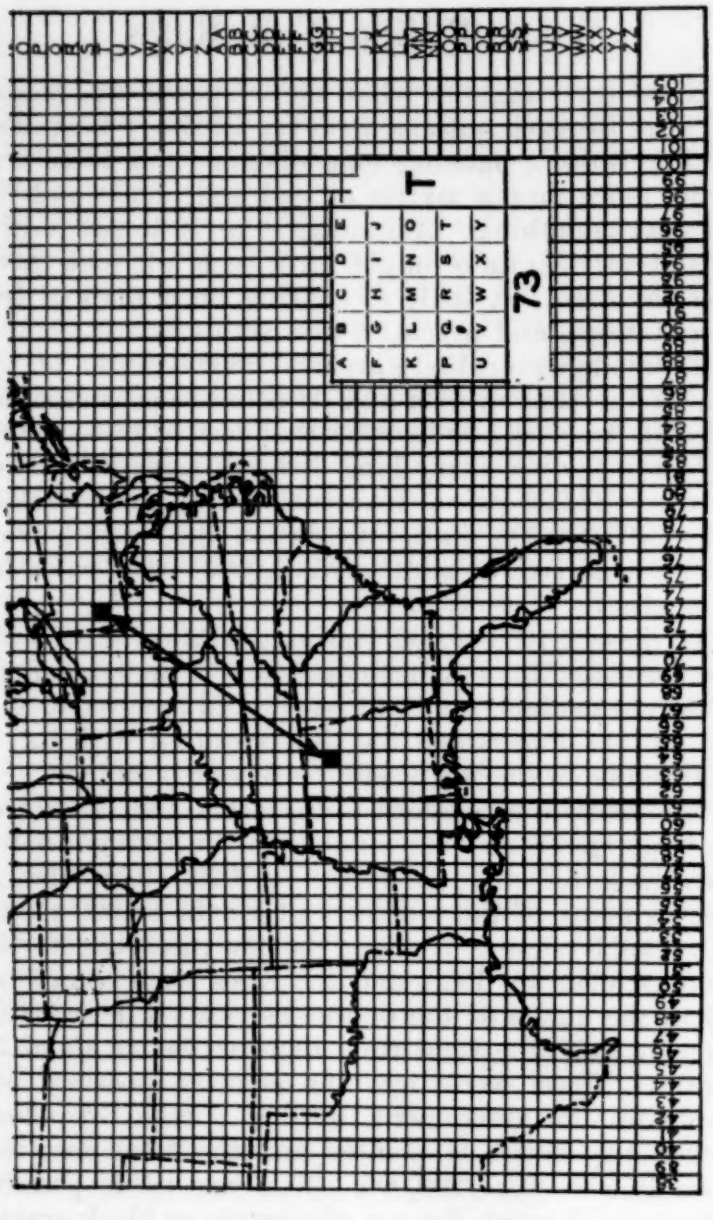
Seven Billion Toll Rates

IN the early eighties when the telephone was beginning to reach out and to cover territory neighboring Boston, figuring long distance toll rates was hardly more than a matter of pad and pencil and the cost next to nothing. Assuming 40 or 50 towns receiving toll service, there might have been, all told, 2,000 rates involved. A little measuring on a map, a few computations, and presto! a new set of tariffs.

Today, however, there are over 88,000 points on the lines of the Bell System and its connecting companies in North America and in order that each of these points may have the necessary long distance rates to each of the other 87,999 points involves setting up a total of over 7,700,000,000 station-to-station day rates, from which are derived an additional 31,000,000,000 rates for other classes of service.

If these 7,700,000,000 station-to-station day rates, now necessary for our business, were to be determined by the old method, the total cost would amount to several million dollars and the time required with, say a 1,000 clerks on the job, would be several years.

An example of modern preparation and issuing of rates was given in connection with the change in toll rates made effective February 1, 1929. This change affected many of the toll rates of all the 88,000 points in the Bell System. Work on the new rates was started about October 15, 1928, and the rates were completed and in the hands of the operators ready for use February 1, 1929, the total time required being about 3½ months. There were over the country possibly 500 people on the assignment, only a portion of whom worked the entire 3½ months and the total cost was probably not over $200,000. This was made possible principally through the use of a group or block system in computing and setting up the new rates.



This sketch illustrates the arrangement of the blocks and sections and the numbering scheme used.

The block system used by the Bell System and Connecting Companies has been laid out to include the entire continent. The blocks, seven miles square, and the sections (a group of 25 blocks), 35 miles square, have been plotted on maps obtained from the United States Government at Washington, the Canadian Government at Ottawa, and the Mexican Government at Mexico City. A suitable numbering scheme is used to designate each block and section of the system and for rate purposes, each city is assigned the block and section number of the particular block and section in which it is located.

Toll rates under this system are determined by three methods. Up to 40 miles rates are based on the direct air line distance between the points as measured on the government maps. Between 40 and approximately 350 miles rates are based on the computed air line distance between the centers of the seven-mile blocks and all points in a block take the same block rates. Finally, for distances greater than 350 miles the rates are based on the air line distance between the centers of the 35-mile sections and all points in a section take the same section rates. As the blocks and the sections used are the same size throughout the continent, the same rates for equal distances are always obtained under a given rate schedule. Therefore, under a given rate schedule the charts can be printed in quantities from a single set up of type and used anywhere, it being necessary only to give them the proper block and section designations to make them applicable to a particular locality.

The toll tariffs as set up for use of the operators, the accounting departments and commercial offices, contain in each case a List of Stations, a First Reference List, Block Rate Charts, Section Rate Charts and a Table of Rates. The First Reference List shows the names and station-to-station day rates to all points within 40 miles where the direct air line rate applies

EFFECTIVE JULY 21, 1927. **LIST OF STATIONS** **ALABAMA**

NOTE: In Toll Center column first entry is for Long Lines traffic. In Toll Center column all entries are for Associated Company traffic.

STATION	USE RATE TO	TOLL CENTER
Abanda (54)	JJ 66-f	{La Grange, Ga. Ref. Roanoke★
Abbeville	MM 67-c	{Montgomery Ref. Dothan★
Abbot (Mobile Co.)	OO 62-s	Mobile
Aberfoil	Union Springs (LL 66-d)	Union Springs
Abernant	JJ 63-e	Birmingham
Ackerville	Snow Hill (LL 64-r)	Selma
Active	KK 64-b	Selma
Ada	LL 63-f	Montgomery
Adamsburg	Sigabee (GG 66-u)	Fort Payne
Adamsville	Pinkney City (II 64-L)	Birmingham
Adger	JJ 64-a	Birmingham
Akron (Lock Eight)	KK 63-a	Eutaw
Alabama City	Gadsden (HH 65-s)	Gadsden
Alabaster	JJ 64-h	Birmingham
ALBANY (54)	GG 63-t	Albany
Alberta	LL 63-f	Selma
ALBERTVILLE (35)	HH 65-b	Albertville
Alco (Tuscaloosa Co.)	JJ 63-f	Tuscaloosa
Aldrich	JJ 64-m	Calera
ALEXANDER CITY		
Baltzell	KK 62-s	{Selma Ref. Demopolis★
Bangor	HH 64-w	Birmingham
Bankhead	Jasper (II 63-d)	Jasper
Banks	LL 66-w	Troy
Bankston	II 63-k	Jasper
Barachias	Montgomery (KK 65-w)	Montgomery
Barnesville	HH 62-q	Jasper
Barney Mines	Cordova (II 63-j)	{Birmingham Ref. Dora★
Barnwell (Baldwin Co.)	OO 63-v	Fairhope
Barnwell (Walker Co.)	Dora (II 63-j)	{Birmingham Ref. Dora★
Barton	GG 62-m	Sheffield
Bartonville	Birmingham (II 64-r)	Birmingham
Bashi	LL 62-y	Thomasville
Bass	Stevenson (FF 65-y)	Stevenson
Batesville	LL 67-g	Eufaula
Battle Ground	Beulah Church (HH 64-f)	Cullman
Battles	Fairhope (OO 63-p)	Fairhope
		{Mobile

Portion of "List of Stations."
Note Bangor's Block Number.

FIRST REFERENCE LIST
TOLL RATES

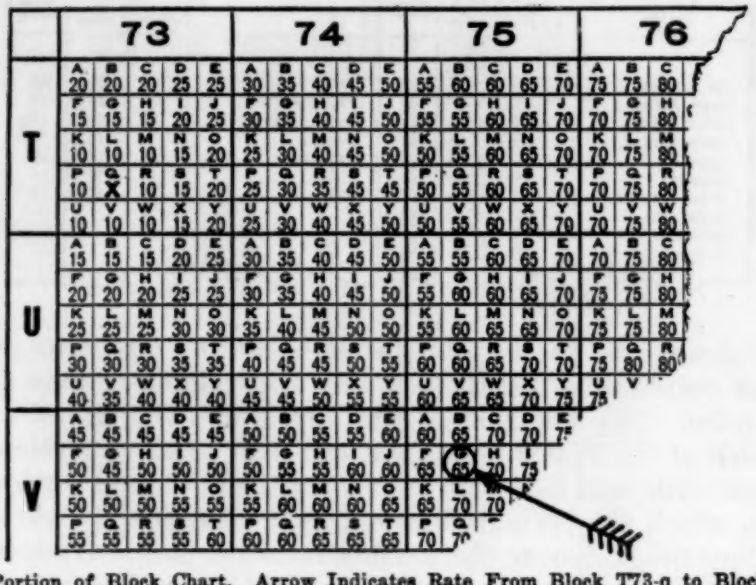
FROM Pittsburgh

TO	STATION TO STATION	PERSON TO PERSON	REPORT CHARGE	TO	STATION TO STATION	PERSON TO PERSON	REPORT CHARGE
La Grange	10	20	10	Palatine	20	30	10
Lake Forest	1.25	1.55	30	Palos Park	15	25	10
Lake Villa	1.40	1.75	35	Park Ridge	10	20	10
Lake Zurich	25	35	10	Peoria	1.80	2.25	45
Lansing	20	30	10	Pistakee	35	50	10
Lemont	15	25	10	Plano	1.35	1.70	35
Libertyville	30	40	10	Plattville	35	50	10
Lockport	20	30	10				
Lombard	15	25	10				
Lyons	10	20	10				

and also the names and station-to-station day rates to all points to which there is any appreciable volume of traffic. (*a*) The List of Stations shows the names of each of the 88,000 points reached over the Bell System and with each name the number of the block and section in which the point is located. (*b*) The Block Charts show the station-to-station day rates for points from 40 to 350 miles distant and the Section Charts the station-to-station day rates for points more than 350 miles distant. The Table of Rates contains the corresponding rates for classes of service other than station-to-station, for each station-to-station day rate from 10 cents to 20 dollars.

With this material set up for a particular point, the rate may be determined from that point to any one of the other 87,999 points in the List of Stations. For example: Assume that a Pittsburgh operator desires the station-to-station day rate from Pittsburgh, Pa., located in Section T73, Block q, written T73–q, to Bangor, Ala. She will not find Bangor with its rate in her First Reference List as the distance is more than 40 miles and there is no appreciable volume of traffic. She will, therefore, obtain the number of the block in which Bangor is located, HH64–w, from her List of Stations and after first finding that this block is not shown on her block rate charts, the distance being more

BLOCK RATES FROM



Portion of Block Chart. Arrow Indicates Rate From Block T73-q to Block V75-g.

than 350 miles, will, by reference to the grid of her section rate chart, locate the section HH64. In this section she will find printed in red ink the rate $2.35. Rate charts show only the initial period rates for station-to-station day service and reference is made to the Table of Rates to determine the corresponding rate for other classes of service and for overtime after first determining the station-to-station initial rate as described.

SECTION RATES FROM

SECTION No. T 73

SHEET No. 1

	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	43	42		
73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	103	104		
X										160	170	180	195	205	215	235	235	375	400	T	
										160	170	180	195	205	215	235	235	400	400	U	S
										165	170	180	195	205	215	235	[illegible]	400	400	V	R
										165	175	185	195	205	215	235	[illegible]	400	400	W	Q
										165	175	195	205	215	235	235	[illegible]	400	400	X	P
									165	170	180	195	205	215	235	[illegible]	[illegible]	400	400	Y	O
									170	175	185	195	205	215	235	[illegible]	[illegible]	400	400	Z	N
								165	175	185	195	205	215	235	235	[illegible]	[illegible]	400	400	AA	M
							165	175	180	195	205	205	215	235	[illegible]	[illegible]	400	400	400	BB	L
					165	170	175	180	195	195	205	215	235	235	[illegible]	[illegible]	400	400	400	CC	K
160	160	165	165	165	170	175	185	195	195	205	215	235	235	255	[illegible]	[illegible]	400	400	425	DD	J
170	170	170	175	175	180	185	195	205	205	215	235	235	235	255	[illegible]	400	400	400	425	EE	I
180	180	180	185	195	195	195	205	205	215	235	235	235	255	255	[illegible]	400	400	425	425	FF	H
195	195	195	195	205	205	205	215	215	235	235	235	255	255	[illegible]	400	400	400	425	425	GG	G
205	205	205	205	215	215	215	235	235	235	255	255	255	275	[illegible]	400	400	400	425	425	HH	F
215	215	215	215	235	235	235	235	235	255	255	255	275	[illegible]	400	400	400	425	425	425	II	E
235	235	235	235	235	235	235	255	255	255	255	275	[illegible]	[illegible]	400	400	400	425	425	450	JJ	D

Portion of Section Chart. Arrow Indicates Rate from Section T73 to Section HH64.

RATE TABLE

Corresponding Rates for different Classes of Service

STATION to STATION						PER – PER APT, MQ		RPT CHG
Day, Evening and Night								
Initial		Overtime						
.10 – 5 mins.		.05 – 3 mins.				.20 – .05		.10
.15 – 5 "		.05 – 2 "				.25 – .05		.10
.20 – 5 "		.05 – 2 "				.30 – .10		.10
.25 – 5 "		.05 – 1 "				.35 – .10		.10
.30 – 3 "		.10 – 1 "				.40 – .10		.10
.35 – 3 "		.10 – 1 "				.50 – .15		.10
Day		Evening		Night				
3 Mins	Add Min	3 Mins	Add Min	3 Mins	Add Min			
.40 –	.10	.35 –	.10	.35 –	.10	.55 –	.15	.10
.45 –	.15	.35 –	.10	.35 –	.10	.65 –	.20	.10
.50 –	.15	.40 –	.10	.35 –	.10	.70 –	.20	.15
.55 –	.15	.40 –	.10	.35 –	.10	.75 –	.25	.15
.60 –	.20	.45 –	.15	.35 –	.10	.80 –	.25	.15
.65 –	.20	.50 –	.15	.35 –	.10	.85 –	.25	.15
.70 –	.20	.55 –	.15	.35 –	.10	.90 –	.30	.20
.75 –	.25	.55 –	.15	.40 –	.10	.95 –	.30	.20

STATION to STATION						PER – PER APT, MQ		RPT CHG
Day		Evening		Night				
3 Mins	Add Min	3 Mins	Add Min	3 Mins	Add Min	3 Mins	Add Min	
3.50 to 3.70	– 1.00	2.80 –	.90	1.90 –	.60	4.50 – 1.50		.90
3.75 " 3.95	– 1.25	3.00 – 1.00		2.00 –	.65	4.75 – 1.50		.95
4.00 to 4.20	**– 1.25**	**3.25 – 1.00**		**2.25 –**	**.75**	**5.00 – 1.50**		**1.00**
4.25 " 4.45	– 1.25	3.50 – 1.00		2.50 –	.80	5.25 – 1.75		1.00
4.50 " 4.70	– 1.50	3.75 – 1.25		2.50 –	.80	5.75 – 1.75		1.00
4.75 " 4.95	– 1.50	4.00 – 1.25		2.75 –	.90	6.00 – 2.00		1.00
5.00 to 5.20	**– 1.50**	**4.25 – 1.25**		**3.00 – 1.00**		**6.25 – 2.00**		**1.00**
5.25 " 5.45	– 1.75	4.25 – 1.25		3.00 – 1.00		6.50 – 2.00		1.00
5.50 " 5.70	– 1.75	4.25 – 1.25		3.00 – 1.00		7.00 – 2.25		1.00
5.75 " 5.95	– 1.75	4.50 – 1.50		3.25 – 1.00		7.25 – 2.25		1.00
6.00 to 6.20	**– 2.00**	**4.75 – 1.50**		**3.50 – 1.00**		**7.50 – 2.50**		**1.00**
6.25 " 6.45	– 2.00	5.00 – 1.50		3.50 – 1.00		7.75 – 2.50		1.00
6.50 " 6.70	– 2.00	5.25 – 1.75		3.75 – 1.25		8.25 – 2.75		1.00
6.75 " 6.95	– 2.25	5.50 – 1.75		4.00 – 1.25		8.50 – 2.75		1.00
7.00 to 7.20	**– 2.25**	**5.50 – 1.75**		**4.00 – 1.25**		**8.75 – 2.75**		**1.00**
7.25 " 7.45	– 2.25	5.75 – 1.75		4.25 – 1.25		9.00 – 3.00		1.00
7.50 " 7.70	– 2.50	6.00 – 2.00		4.50 – 1.50		9.50 – 3.00		1.00
7.75 " 7.95	– 2.50	6.25 – 2.00		4.50 – 1.50		9.75 – 3.25		1.00

Long Toll Cable Construction and Maintenance

ONE of the most important considerations confronting the Long Lines Department of the American Telephone and Telegraph Company is the construction and maintenance of long toll cables. During 1928 there was added about 1,500 miles of cable to the network stretching across the northeastern section of the country. It is possible to talk through cable from north of Portland, Me., all the way to Greensboro, N. C., in the South, to Davenport, Ia., and St. Louis in the West, and to all important centers in the intervening territory. Construction plans for the next few years contemplate further extension of this system to the north, west, and south, and reinforcement of the existing network.

The important factors in selecting a toll cable route are avoidance of circuitous routes, freedom from power exposures and fire hazards, suitability of repeater station locations and feasibility of right-of-way from the standpoint of its cost together with the attendant construction and maintenance problems. In general, long toll cables are run on direct routes between large cities principally on private right-of-way and often through rather rough country. Some companies secure all new right-of-way on a form of grant in which the property owner agrees to construct no inflammable structure within fifty feet of the cable line. It is impracticable to secure such protection if the cable line is on a highway. Furthermore, highways also introduce existing fire hazard difficulties, and often involve later rearrangements due to highway changes. The tendency therefore is towards either all underground routes or private right-of-way aerial routes with underground through cities.

Preliminary Work

Scheduling and programming cable construction work are important because of the length of time required to plan and construct a long toll cable. Right-of-way permits and franchises should be obtained well in advance in order to avoid delays or changes in plans after material has been ordered or loading spacing laid out. The locating and staking work should be done under the supervision of engineers having in mind the problems of the Construction Department. It is also important to complete negotiations for railroad, river and power crossings well in advance of the construction work.

Pole Line Messenger and Conduit Work

Since aerial toll cables are usually placed on new pole lines free of open wire construction, the building of a cable pole line is an undertaking which can be handled on a large scale production basis. Digging machines, tractors and air compressors may be used to advantage. Messenger and ring work follows the pole line construction and requires no special discussion. Conduit work is usually handled by contract although close supervision is required. In this connection duct assignments are an important engineering consideration in that they involve future maintenance of underground cable. Improper duct assignments lead to no end of difficulties, particularly in cities where there are large requirements for local distribution. It is important that the toll cables be placed and racked where they will be least disturbed.

Cable Placing

Pulling cable in underground systems is well standardized. The placing of aerial cable, however, still partakes of many problems incident to the wide variation in local conditons surrounding its erection. In general, there are two methods, one in which cable reels

are spotted by a separate gang ahead of the cable pulling outfit, the latter outfit jacking up the reels when ready to pull, and a second method in which the cable is pulled direct from the cable reel trailer. From studies which we have made it appears that the first method is best adapted to very rough country where long hauls with tractors are necessary in order to spot the reels in difficult rights-of-way, whereas the second method saves time and expense, providing the country is relatively flat and accessible to good roads. Tractors fitted with winches, and other special equipment, are justified on large projects.

Splicing

Because the cable and strand have different coefficients of expansion it is necessary to compensate for this by splicing the cable under tension whenever the temperature is below 40° F. in order to minimize buckling in subsequent hot weather. This necessitates securing the cable with a grade clamp in the middle of each length and pulling the ends of the cable together at the point where a splice is to be made. This tension stretches the cable to an amount which approximately compensates for the difference in the coefficients of expansion between the cable and strand. The tension set up also straightens the cable, eliminates curves and bends at poles and aids in preventing accumulation at these points when the cable expands under rising temperature.

Gas Pressure Testing

Gas pressure testing is a subject in which every cable man is vitally interested. The advantages of testing out new construction work with gas pressure are generally well recognized. The method is simply one in which a completed loading section is filled with nitrogen gas before cutting in the loading, both ends of the section being capped. After the pressure is equalized, pressure gauge readings at both ends are

noted and then rechecked a day later. If the recheck indicates that gas is being lost, the several splices involved are soaped to locate the point where the gas is escaping, or the cable ridden to find a crack or puncture. The success of this method of testing out new construction has led to further experiment with a view to maintaining toll cables under gas pressure. This will be touched upon subsequently in this paper.

Completion and Service Tests

Completion and service tests are important considerations which should not be overlooked in scheduling a new toll cable. The completion tests are comprehensive and extensive and comprise the following measurements on all circuits:

Insulation
Loop resistance
Crosstalk
Resistance unbalances
Impedance unbalances
Impedance runs

Usually some errors are found and time must be allowed for clearing them. When the cable passes these tests satisfactorily it is considered completed but service tests, consisting of a check of impedance and a transmission test, must also be made for each circuit as it is put in service.

In meeting a service date there is a tendency to continue construction right up to the service date. This may be necessitated by bad weather, improper planning or delays of one sort or another which cause the Construction Department to get behind its schedule. The completion tests and the service tests suffer from delays in the construction schedule. It is important therefore to make allowances where possible for delays in order that proper time will be allowed for the completion and service tests prior to putting the cable in service.

Cable Maintenance

Cable maintenance grows as a problem not only because of the amount concerned and the fact that much service is in the sheath but also because, as the cable ages, there is an accumulation of things all of which seem to operate in the direction of increasing causes of trouble. On underground cables the major trouble making factors are highway changes, subsurface operations of others, electrolysis, improper racking in manholes, heavy road vibration, interference by our own workmen, floods, etc. Similarly, on aerial cables the trouble making factors are bullet holes, tree interference, buckling and ring cuts, fires and electrical burns, etc.

The principal consideration in cable maintenance is to keep the sheath water tight. Constructive suggestions along the line of preventive maintenance are as follows:

For Underground Cables, more consideration to proper duct assignments, better set-ups and more careful racking in manholes, better contact with municipalities and highway contractors, education of employees designed to promote a more careful handling of cables in underground runs, suitable designations for toll cables, better electrolysis surveys particularly those which involve the maintenance of existing drainage connections in conduit and more frequent inspections of manholes.

For Aerial Cables, more frequent inspections, better contact with municipalities and highway contractors, splicing aerial cable under tension during construction and particularly straightening out of aerial cable before splicing, in order to eliminate irregularities which later develop into buckles and ring cuts, elimination of fire hazards and construction of new cables over routes which are free from fire hazards, cleaner and wider right-of-way.

Fire Hazards

The protection of aerial cables from fire in adjacent inflammable structures has been given much thought. Hazards have been eliminated by rerouting the line, by moving the hazard and by constructing underground dips. When these methods are not practicable and wherever there is a reasonable separation between the hazard and the cable, consideration has been given to protecting the cable and messenger with a fire resisting shield.

After many tests, a cylinder of asbestos shingle material, split longitudinally, is being tried out. The edges are butted by means of a copper strip of " H " cross-sections and the completed cylinder is bound with copper bands. Shields weigh from 7 to 10 lbs. per foot and require an additional messenger strand for support. We expect this arrangement to be satisfactory for small buildings twenty feet or more from the cable line.

Trouble Clearing

Trouble clearing is that phase of maintenance which deals with locating and repairing the cable sheath or conductors after the damage has been done. Testing apparatus and methods have been perfected to a point where they are very accurate in trouble locations. The new Wheatstone bridge, together with temperature correction curves and intensive training of testboard employees, all have done much to improve testing results.

New cables are being manufactured with one quad of enameled wire in order to assure a good wire for Varley measurements even though a cable may be saturated with water at a given point. Leak alarm circuits are being tried out placed in the outside layers and connected with alarm devices in central offices in order to assist testboards in detecting cable troubles in the early stages.

Permanent Gas Pressure

The testing methods referred to above are based on locating sheath defects after moisture has entered the cable and grounded certain conductors. Thus impaired service is a prior condition to locating and clearing the trouble. In underground cables this is particularly serious since a trouble may not be detected or located until a cable has failed altogether. This brings us to the subject of permanent gas pressure on toll cables. Its effectiveness in avoiding service interruptions should not be interpreted to mean that it eliminates the need for preventive maintenance. Permanent gas pressure will not prevent sheath breaks. It does, however, enable us to locate and clear sheath breaks before service is affected. Therefore, it is important not to neglect the cable sheath merely because gas pressure gives us a means of locating sheath breaks before service is affected.

Briefly, the work which has been done to date in placing toll cables under permanent pressure, includes sealing the cable at both ends and at all lateral taps with beeswax plugs, installed without interrupting service. In addition to plugging the cable at the ends and at lateral taps, intermediate plugs are installed at approximately 10-mile intervals, in order to sectionalize the cable for use in locating sheath breaks. Tire valves are soldered into the sheath at approximately one-mile intervals. Gas is introduced at approximately 40 pounds pressure at each valve in the section. When equalized throughout the section the pressure is between 15 and 20 pounds. The cable is also equipped with alarm gauges which automatically indicate in adjacent test rooms any lowering of the pressure in any section of the cable.

Drying out with Gas

Another important advantage of the nitrogen gas in maintenance work is the drying property of the gas

EXISTING ROUTES OF LONG TOLL CABLES
BRUNSWICK
PORTLAND
PORTSMOUTH
GLOUCESTER
BOSTON
BUZZARDS BAY
EDGARTOWN
NANTUCKET
WORCESTER
PROVI-
DENCE
NEW HAVEN
AMAGANSETT
SPRINGFIELD
HARTFORD
NEW YORK
POINT PLEASANT
PHILADELPHIA
ATLANTIC CITY
OCEAN CITY
UTICA
ALBANY
LIBERTY
BALTIMORE
NEWPORT NEWS
NORFOLK
SCRANTON
SHAMOKIN
READING
HARRISBURG
WASHINGTON
RICHMOND
PETERSBURG
DURHAM
NIAGARA FALLS
ROCHESTER
SYRACUSE
BUFFALO
BINGHAMTON
MIDDLETOWN
FREDERICK
TORONTO
ST. CATHERINES
CLEVELAND
CHARLEROI
PITTSBURGH
FAIRMONT
CLARKSBURG
CHARLESTON
LYNCHBURG
GREENSBORO
PORT
HURON
DETROIT
TOLEDO
FINDLAY
COLUMBUS
DAYTON
CINCINNATI
SAGINAW
ANN ARBOR
KALAMAZOO
GRAND RAPIDS
SOUTH BEND
INDIANAPOLIS
LOUISVILLE
BENTON
HARBOR
TERRE HAUTE
MILWAUKEE
CHICAGO
WATERTOWN
MADISON
ROCKFORD
SPRINGFIELD
WYANET
PEORIA
DAVENPORT
ST LOUIS

admitted on either side of a cable which is wet. In several instances, we have avoided pulling in and cutting over a new section of cable. In many other instances we have practically restored complete telephone service within three or four hours after a failure. In these latter cases, the gas was applied and the drying out process continued up to the time when the duct was rodded, the new cable pulled in and the splicers were ready to cut over. The drying out process not only restored practically all of the telephone service, but materially aided the splicers in toning through the defective section when cutting over. We are reasonably certain that only those cases where the cable is slightly wet can be dried out completely with gas. Cases where the cable is thoroughly saturated with water must be handled in the usual manner—either replacing the section or cutting in a short piece of cable. The gas, however, is helpful in all cases in partially restoring service prior to the cutover and in aiding splicers in the actual work of cutting over.

L. N. STOSKOPF.

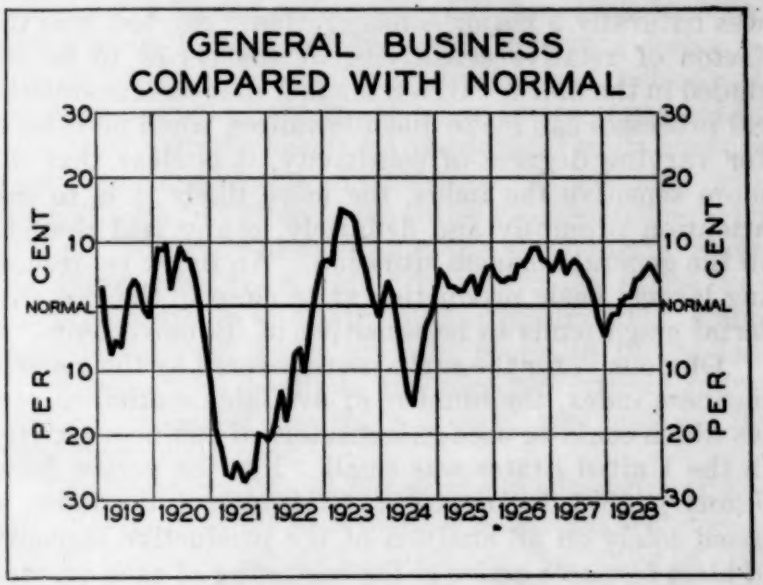
An Index of General Business Activity

THE recent completion of a revision, for the period since January, 1919, of the index of general business activity in the United States, constructed by the Chief Statistician's Division of the American Telephone and Telegraph Company, furnishes a pertinent occasion for the brief discussion of that index, which is the subject of this article. The chart on the following page shows the revised index—frequently called a " general business curve "—for the decade 1919 to 1928, inclusive. While the revision of the index has not materially altered the appearance of the curve from its previous aspect, nevertheless since certain recently available industrial statistics and newly developed methods of statistical analysis were employed in the process of revision, it is felt that the new index has some distinct improvements over the former one as an indicator of the course of general business activity in the country as a whole.

As has been pointed out in previous articles in this QUARTERLY,[1] it has been found useful in the Bell System to have available a measure of fluctuations of business activity outside the telephone industry, as a basis for comparisons with fluctuations within the telephone business. This is so in spite of the fact that the telephone business as a whole is one of exceptional stability, relative to its long-term rate of growth, as compared with many classes of manufacturing and merchandising industries. Statistical analysis has indicated, however, that in certain phases of the telephone business there are fluctuations due to factors other than those reflected in long-term growth and seasonal characteristics, and that these fluctuations tend to synchronize with the so-called " cyclical " fluctuations in external busi-

[1] *The Statistical Study of General Business Conditions*, October, 1924; *Measures of Regional Business Activity*, April, 1928.

ness activity. It is clear, therefore, that a measure of general activity based on significant indices, sufficient in number to be relatively free from the peculiarities inherent in any single external index that might be selected, would be a substantial aid in interpreting fluctuations of such elements within the telephone business. Furthermore, not only would such an index be of service in evaluating past tendencies and in interpreting current performance, but it would also provide a basis whereby forecasts of general business activity might be expressed in quantitative terms and might therefore be more easily applied in the preparation of estimates of future telephone operations and results.



Character and Composition of the Index

In the major cyclical movements of general industrial activity upward or downward, it is likely to be true that most important industries are moving in unison at least as to direction. There have, of course, always been certain industries or lines of business which at

any given time have moved counter to the general picture either because one man's meat is another man's poison, or because they tended to precede or to lag behind the general run of industries in their movements. Telephone traffic, however, as has been indicated, tends to move pretty much in step with the general average of industrial activity at any given time. It therefore seems clear that the general business index against which telephone movements would be compared, should be primarily an index which gives a reasonably good composite picture of fluctuations in external activity. This circumstance conditioned in no small measure the type of index to be constructed on the basis of such statistics as were available. The availability of statistics was naturally a major consideration. So, too, was the factor of relative sensitivity of the series to be included in the index. Given the fact that certain statistical processes can make due allowances, when necessary, for varying degrees of sensitivity, it is clear that the more sensitive the index, the more likely it is to call attention promptly and definitely to any real changes in the general business situation. An index representing largely basic production at or close to the raw material stage tends to be sensitive in its movements.

Obviously, for the early years covered by the general business index, the number of available statistical series which could be used as indicators of business activity in the United States was small. For the period from January, 1877, to December, 1884, indeed, the index is based solely on an analysis of the productive capacity of blast furnaces active at the beginning of each quarter of the year.[2] Beginning with January, 1885, monthly bank clearings outside of New York City were added to the composition of the curve, and in the same year figures on blast furnace capacity became available

[2] As indicated, the general business index extends back to 1877, although the accompanying chart shows the curve only over the period involved in its latest revision. The monthly points of the index since 1877 are given in the table at the end of this article.

monthly instead of quarterly. For the eleven years ending in 1902, the curve had three components: blast furnace capacity, bank clearings, and Bradstreet's monthly index of wholesale prices. Later on other series of data were added, and certain ones were dropped from time to time. Among these were pig iron production, gross operating revenues of railroads, net surplusages or shortages of freight cars, copper production, revenue freight car loadings, net ton miles of freight carried by Class I railroads, bituminous coal production, steel ingot output, electric power production, lumber production, consumption of raw cotton by textile mills, etc.

Prior to the recent revision of the index, the composite curve for the period since October, 1923, included eleven series of figures. No series involving dollar totals or prices were employed during that period; all the components of the index being series representing volume of activity measured in physical units, such as tons of coal, or bales of cotton, or cars loaded with freight. All but three of the series represented activity in basic industries at or close to the raw material stage, the three exceptions being two railroad series and monthly statistics of electric power production. These three last named series are still found in the revised curve, which, in addition, includes ten strictly industrial series, all of the same general character as the eight previously used.

The latest revision of the general business index was undertaken in order to provide a consistent set of component items for the period since the beginning of 1919 and to incorporate revised seasonal factors and trends wherever necessary. As a result of a thorough review of available industrial statistics, and of the significance of these statistics for the fundamental purpose of the index, series of statistics representing the following items were selected: cotton consumption, woolen machine hours active, pig iron production, steel ingot pro-

duction, lumber production, sole leather production, gasoline production, bituminous coal production, copper production, zinc production, electric power production, freight car loadings, and net freight ton miles. Many other series were considered in this review, but were discarded for one reason or another. Moreover, experiments have shown that the inclusion of additional series of similar character would not perceptibly affect the movements of the composite curve based upon the 13 series above mentioned.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY GENERAL BUSINESS CURVE

(Expressed in terms of percentage deviations from normal)

	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
Jan...	− 9	− 8	−13	+ 7	+12	+11	+ 9	−10	−16*	−10	− 2	− 2	+ 6
Feb...	− 9	− 9	−13	+ 9	+12	+11	+ 7	− 9	−19	− 8	+ 3	− 2	+ 5
Mar...	−10	−10	−13	+11	+12	+12	+ 4	− 8	−17	− 6	+ 9	− 7	+ 3
Apr...	−11	−11	−13	+12	+12	+12	+ 2	− 8	−16	− 8	+ 8	− 6	+ 1
May..	−10	−11	−11	+10	+12	+10	+ 2	− 7	−19	− 7	+ 8	− 2	+ 4
June..	− 8	−12	− 9	+ 8	+13	+ 8	+ 1	− 6	−14	+ 3	+ 6	− 2	+ 2
July...	− 7	−12	− 7	+ 7	+13	+ 5	+ 1	− 6	−11	+ 4	− 2	− 3	+ 7
Aug...	− 7	−12	− 3	+ 7	+13	+ 7	+ 1	− 8	−15	+ 2	+ 2	+ 2	+ 6
Sept...	− 7	−12	+ 2	+ 7	+12	+ 9	+ 2	−10	−14	+ 2	+ 7	+ 2	+ 1
Oct...	− 7	−12	+ 6	+ 7	+12	+10	+ 2	−12	−12	+ 1	+ 5	+ 8	+ 8
Nov...	− 7	−12	+ 6	+ 9	+12	+10	− 2	−15	−11	+ 2	+ 7	+ 2	+ 7
Dec...	− 8	−13	+ 7	+11	+11	+ 9	− 6	−18	− 9	+ 3	+ 1	+ 3	+ 5
Av....	− 8	−11	− 5	+ 9	+12	+10	+ 2	−10	−14	− 2	+ 4	− 1	+ 5

	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Jan...	+11	+ 5	+ 9*	+12	−14	− 3	− 1	−13	− 3	+ 1	+10	− 1	+ 2
Feb...	+ 8	+ 1	+14	+12	−16	− 9	− 2	−11	− 2	+ 1	+11	0	+ 2
Mar...	+10	− 5	+11	+12	−14	−10	− 7	−12	− 3	+ 4	+10	+ 2	+ 2
Apr...	+12	− 6	+ 9	+11	−14	−11	− 5	−12	− 7	+ 1	+ 8	+ 5	+ 5
May..	+17	− 7	+ 7	+11	−14	− 8	− 8	−15	− 7	+ 2	+ 6	+ 4	+ 5
June..	+15	0	+ 9	+ 5	−20	− 6	− 8	−13	− 4	+ 3	+ 6	+ 3	+ 2
July...	+16	+ 8	+ 6	− 2	−18	− 1	− 8	−14	− 8	+ 3	+ 3	+ 4	+ 4
Aug...	+12	+ 7	+ 6	−13	−10	0	−14	−10	− 5	+ 6	0	+ 4	+ 3
Sept...	+15	+13	+ 7	−17	− 7	+ 1	−16	− 3	− 5	+ 8	− 3	0	+ 6
Oct...	+17	+12	+ 8	−17	− 7	+ 6	−17	− 4	− 7	+ 9	− 3	+ 3	+ 5
Nov...	+ 8	+ 7	+10	−16	− 6	+ 4	−16	− 4	− 4	+ 8	− 4	+ 2	+ 2
Dec...	+ 5	+ 7	+12	−15	− 4	+ 3	−13	− 2	− 2	+11	− 4	+ 1	+ 3
Av....	+12	+ 4	+ 9	− 1	−12	− 3	−10	− 9	− 5	+ 5	+ 3	+ 2	+ 3

Statistical Processes

Before the series are combined into the general composite index, each series is adjusted for its own seasonal variation and its computed long-time trend, with the further refinement for the years subsequent to 1919 that, where appropriate, the monthly data have first been reduced to a daily average basis before adjustment for seasonal factors, in order to eliminate all changes due merely to calendar shifts. After seasonal and trend adjustments have been made, the monthly data have been expressed as percentage deviations from the

American Telephone and Telegraph Company General Business Curve

(*Expressed in terms of percentage deviations from normal*)

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan...	+ 3*	−10	− 5	+10	+17	−14	− 5*	+12	0	− 2	+10*	0	−16
Feb...	+ 1	− 5	− 5	+ 9	+14	−15	− 5	+10	− 1	+ 3	+ 8	− 2	−13
Mar...	+ 2	− 8	− 2	+ 7	+15	−15	− 5	+12	0	+ 3	+ 3	0	−12
Apr...	+ 4	− 6	− 1	+ 5	+16	−14	− 5	+11	− 3	+ 6	+ 5	− 1	− 9
May..	+ 3	− 8	0	+ 8	+18	−17	− 3	+ 6	− 2	+ 5	+ 5	− 5	− 8
June..	+ 2	−10	0	+ 7	+16	−17	− 2	+ 7	− 1	+ 3	+ 4	− 4	− 4
July...	+ 3	−12	− 1	+ 7	+18	−16	+ 1	+ 4	− 2	+ 5	+ 5	− 2	− 3
Aug...	− 1	−12	0	+ 8	+16	−13	+ 2	+ 4	− 1	+ 6	+ 2	− 8	− 2
Sept...	− 2	− 8	+ 2	+ 5	+12	−11	+ 5	+ 4	− 1	+ 5	+ 3	−10	+ 2
Oct...	− 6	− 9	+ 2	+10	+13	−11	+ 8	+ 4	− 1	+ 8	+ 5	−13	+ 5
Nov...	−11	− 4	+ 4	+11	− 4	− 9	+ 9	+ 2	− 1	+ 7	− 1	−17	+ 9
Dec...	−14	− 5	+ 7	+13	−12	− 8	+10	+ 1	− 2	+ 7	− 2	−18	+14
Av....	− 1	− 8	0	+ 8	+12	−13	+ 1	+ 6	− 1	+ 5	+ 4	− 7	− 3

	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Jan...	+11	+17	+ 4	+ 3*	+ 9*	−19	−20	+ 7	+ 1	+ 5	+ 5	+ 5	− 3
Feb...	+12	+13	+ 3	− 3	+ 9	−22	−17	+ 6	+ 4	+ 5	+ 4	+ 6	− 2
Mar...	+13	+14	+10	− 8	+10	−26	−13	+11	+ 2	+ 3	+ 4	+ 8	− 1
Apr...	+ 9	+12	+10	− 5	+ 3	−27	−18	+15	− 3	+ 3	+ 4	+ 5	0
May..	+12	+14	+13	− 6	+ 7	−24	−14	+15	− 9	+ 2	+ 4	+ 6	+ 1
June..	+11	+12	+10	− 2	+ 9	−26	− 8	+14	−14	+ 2	+ 6	+ 7	+ 1
July...	+ 8	+10	+14	+ 3	+ 8	−27	− 6	+13	−15	+ 3	+ 6	+ 6	+ 4
Aug...	+12	+10	+15	+ 4	+ 7	−26	−10	+ 9	−11	+ 4	+ 7	+ 5	+ 4
Sept...	+13	+ 7	+11	+ 3	+ 5	−25	− 5	+ 6	− 7	+ 2	+ 9	+ 3	+ 5
Oct...	+15	+ 9	+10	− 1	+ 1	−20	− 1	+ 3	− 3	+ 4	+ 9	0	+ 6
Nov...	+17	+11	+ 5	− 2	− 6	−20	+ 4	+ 1	− 2	+ 6	+ 7	− 3	+ 5
Dec...	+16	+ 6	+ 6	+ 3	−12	−21	+ 7	− 2	+ 2	+ 6	+ 7	− 5	+ 3
Av....	+12	+11	+ 9	− 1	+ 4	−24	− 8	+ 8	− 5	+ 4	+ 6	+ 4	+ 2

* Denotes months in which composition of curve changes.

calculated normal or seasonally adjusted trend. These percentage deviations then represent in each case those fluctuations found in the series in question, which, however they may be explained, are presumably not due to the factor of trend, on the one hand, or to seasonal changes, on the other. That is to say, they show the " business cycle " and other non-recurrent (or so-called " accidental ") fluctuations in the series, which are the movements which the curve seeks to measure. Each series has then been expressed in terms of its standard deviation, and the composite represents a weighted average of the series so expressed.

The determination of the weights which were assigned to the individual series was based upon a number of economic and statistical considerations, of which the principal one is the relative degree of representativeness of the general picture which was believed to inhere in each series. The iron and steel series reflect not merely conditions in the steel industry itself, but also in the principal industries consuming steel, such as the automobile, railroad equipment, building and oil industries. The railroad series and electric power production naturally reflect all types of industrial activity. The railroad series in addition also reflect distribution. And so on through the list, the several series reflect in varying proportions not only their own inherent activity and contribution to the country's industrial life, but also the activity of other industries which consume the products and services of those industries directly represented in the index.

It is easy to overemphasize the influence of the weighting given to component items on the movements of a composite index of general business. It is obvious, however, that a reasonable system of weights, applied to a fair sample of series of data reflecting general business or industrial activity, should help that sample to represent all the better the general economic picture which it aims to portray. That a reasonable system of

weights has been applied in the present case would seem to be indicated by the fact that the revised general business index, although containing only thirteen series, moves in close consonance with certain other indexes comprised of a much larger number of components, such as, for example, the index of industrial production of the Federal Reserve Board.

Undoubtedly this general business index, as well as other general indexes of business activity, may be subject to occasional criticism, particularly by persons outside the telephone industry. On this point, however, it is always well to remember that the index described herein has been constructed primarily for use where applicable in connection with factors within the telephone business. It does not seek to measure the actual amplitude of cyclical fluctuations in all branches of economic activity, but it is merely designed to reflect, in a sensitive way, certain of the external movements which are helpful in studies of the telephone business. If it accomplishes this aim, it serves the purpose for which it is intended.

The two preceding tables show to the nearest per cent. the monthly points on the curve for the 52 years from 1877 through 1928. Each of these points represents the percentage deviation of the index from " normal."

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Standardization in the Bell System—II

Introductory Note

IN the January 1929 issue of the Bell Telephone Quarterly appeared the first part of a paper on "Standardization in the Bell System" prepared in response to a request from the National Industrial Conference Board. A more complete statement regarding the preparation of this paper was given in an introductory note to the first part.

The second and concluding part of this paper is given below.

THE EDITORS.

STANDARDIZATION OF MANUFACTURING PLANT, EQUIPMENT AND PROCESSES

In the Manufacturing Department standardization of manufacturing processes is closely related to standardization of the factory buildings themselves, their fixtures, such as heating and ventilating systems, and general manufacturing equipment. The cost of designing and erecting structures whether required in new locations or as additions to existing plant facilities has been reduced to a minimum by predetermining building unit designs adapted to specific manufacturing requirements, the units being increased in number as requirements demand.

Many years ago a standard building width was adopted which made possible an economizing of building space permitting the use of machinery, benches, racks, etc., with dimensions most suitable for installation in the building. The productivity of a fixed investment in buildings has been increased, and an important economy in the cost of installation of their equipment has been realized.

In the design of buildings for the new manufacturing plant at Kearny, New Jersey, a uniform column spacing is maintained throughout all multi-story buildings. A great many advantages relating to occupancy have been realized from this standardization. An example is a reduction in cost of approximately 50 percent in constructing and erecting metal partitions. Uniform column spacing made it possible to design partition panels of a standard width which is an even fraction of the spacing of columns. This eliminated the necessity of making drawings of each partition installed, as it is sufficient to indicate on the standard floor plans the position of each panel. The cost of constructing and erecting partitions has been reduced by increasing the proportion of construction work which may be performed in the machine shop in larger lots and by economical methods and suitable equipment, rather than in the field where adequate facilities are not available.

It is the responsibility of one organization within the Manufacturing Department to see that all new machinery is in accordance with established standards, or to recommend new standards for new conditions. In some specific cases where another type of machine will be more economical for some heavy running part, it is desirable to depart from these standards. There are many advantages incident to having a standard type machine for each class of work: lower first cost because of volume buying, ease in applying standard safety measures, adaptability to standardized processes, adaptability for use with standardized associated equipment, such as benches and trucks, flexibility of the machine equipment to meet peak loads and interchangeability of machine parts, which reduces the cost of maintenance.

Not only the machines themselves but their associated parts, such as bearings, clutches, hand wheels, control levers, mountings for electrical apparatus and lub-

rication systems, are standardized. As far as possible these standards are applied to the machines purchased as well as to those made in the shops.

Manufacturing fixtures such as shop benches, lockers, racks, trunks, etc. have been standardized and the advantages of such standardization appear daily in the manufacturing work. In preparing arrangements of office and shop departments, as the dimensions of each item to be installed is known in advance its position may be fixed without requiring its measurement in each instance. This not only reduces the cost of fitting manufacturing equipment in the space allotted to it, but also makes possible floor space conservation by the best arrangement of equipment, and important economies later in its operation by providing for the convenience of the workmen. Standardization of these items has had the usual effect of reducing the cost of their manufacture by making possible quantity production of a small number of items, rather than small quantity manufacture of a large number of items.

Considerable benefit has been derived from the standardization of tools and gauges and design practices. Standard and typical drawings have been made for various types of punches and dies, drill jigs, fixtures, and other classes of tools. Parts such as drill bushings, latches, gauge pins, jig feet, clamping cams, punch and die holers, line guide and dowel pins, stops, springs, die blanks, etc., have been standardized. Many of the different sizes of these parts have been replaced by common sizes reducing the sizes stocked to a small percent of the original. This and standardization of design greatly reduced the raw materials necessary to be carried, and in most cases replaced the practice of making parts as required for each tool by the more economical one of producing these parts in quantity lots of few types, to be stocked and drawn for use as required.

Tool steels have been classified and assigned code numbers, and a table lists the proper steels to be used

for standard and common types of tools and parts. Tools and parts purchased from suppliers have been standardized and stocked to avoid duplication, insure interchangeability, facilitate replacement and repair, and secure the advantage of quantity purchasing.

Standardization has simplified and reduced the cost of design work, and has also secured better uniformity and more economy of design, considering manufacture, operation and maintenance. It has permitted the manufacture of standard parts on a quantity production basis with its resulting economy, and due to the selection of available standard designs has facilitated the adoption of standard methods in building of tools to reduce their cost.

As an example of the results of standardization in tool making, when an open compound punch and die of a relatively common type is required, the only design work necessary is to lay out the special die form and to specify by code number the standard parts to be drawn from stock to be assembled in the tool. The majority of these are usually available. The special parts will be made and assembled with the stock items to complete the tool. It is estimated that a tool made by these standards will result in a saving of one third on the average over the cost of producing the same tool by making drawings of each part individually and producing all of the parts at the time the tool was built. This percentage will, of course, vary considerably depending on the type and complexity of the tool and the extent to which standards may be applied.

The manufacturing processes for all material made in large quantities in the Western Electric Company are covered by operating instructions or " manufacturing layouts." A Planning organization originates these manufacturing layouts, directing the employment of processes and equipment that have been carefully standardized to give the highest quality of product and to be most economical of time and material.

Many of the processes that are specified in the manufacturing layouts are covered by process standards. This enables the planning organization merely to specify the proper standard, without going into the detailed description of the process to be followed. For example, wood finishes are covered by standards that specify all of the materials to be used, such as varnishes, shellacs, sandpapers, and rubbing compounds, and give the drying periods. These standards are accompanied by samples of the finish that is to be matched.

Another example is found in the standardization of methods to be used in the carrying out of chemical processes, such as electroplating. In this case the process standard specifies the density of the electrolyte, the temperature, the current intensity, etc.

Heat treating processes are similarly covered by standards so that when a new product is to be made, it is merely necessary to specify the standard in accordance with which it is to be heat treated.

The use of standards of this kind not only simplifies the work of making the manufacturing layouts, but it also simplifies the introduction of the manufacture of new products in the Shop, as the operating people are already acquainted with these standard processes and have the necessary materials and equipment already available.

Standardization in Distribution and Installation

In distributing and installing apparatus and equipment, the standardization of methods, tools and materials is also of great importance.

When the thousands of orders transmitted to the Electric Company for execution and the large number of sources from which these originate are considered the value of standardized methods of ordering is apparent. Standard requisition forms originating with the telephone companies convey the orders, along with necessary shipping instructions, to the distributing

houses of the manufacturer. To facilitate the handling of orders for complicated assemblies of equipment, such as complete central office equipments or large long distance offices, a series of ordering questionnaires has been developed. These questionnaires accompanied by necessary building plans and other drawings provide in an orderly sequence all the data necessary to acquaint the equipment engineers with the detailed requirements of the project; they are designed to suggest the use of standard equipment and arrangements wherever possible.

When such an order requiring engineering work by the Western Electric Company reaches one of its factories, the Equipment Engineering Department translates the telephone companies' requirements into manufacturing specifications and drawings utilizing standard equipment specifications and drawings on eighty to ninety percent of all orders for central office equipment units, such as switchboards, desks, and the mechanical units for dial offices. This results in standardizing the information which goes to the Manufacturing, Installing, and Pricing Departments, and minimizes the effort required to engineer, manufacture, test, install and price the equipment.

Even when supplementary equipment is required to meet certain local conditions and is not suitable for standardization the method of preparing the manufacturing specifications is standardized through the use of standard equipment engineering specification forms, which list the standard editing information for a particular unit of equipment and leave the quantities to be filled in by the engineers. This not only reduces the engineering effort, but also maintains uniformity in arrangement and sequence of the information in the specifications thereby adding greatly to the convenience with which such specifications may be used by other organizations.

An important advantage of equipment standardiza-

tion is that it permits the resultant standardized units to be stocked or otherwise made available on a short delivery basis.

By stocking standard units the delivery intervals on certain types of central office and private branch exchange equipment have been greatly reduced in the past few years. For example, the delivery interval for certain private branch exchange equipments was reduced from six months to one month. Furthermore a great many special features have been dispensed with which were formerly thought necessary when equipment was ordered on a custom built basis, and because of the much smaller variety, production authorizations may now be placed on the Manufacturing Departments in larger quantities or on an even flow basis so that progressive assembly methods may be applied which result in lower overall engineering and manufacturing costs.

As an aid in establishing and maintaining standard equipment designs and in giving such standards necessary publicity with the telephone companies, the manufacturer's standard specifications, stock lists, catalogs, and price lists are published and distributed to the customers.

These plans do not retard the work of the development engineers in effecting improvements in design. Improvements and changes, however, are made on an annual basis unless the advantage of the improvement makes it expedient to introduce it at once. This facilitates the introduction of new designs and minimizes the effect on stocks and schedules.

In the case of central office and toll equipment especially, it is usually the function of the Western Electric Company to erect or install the equipment and to deliver it to the customer as a complete operating unit. Standard methods for planning, estimating and performing the installation work have been established and are prescribed for the guidance of installation crews working in all parts of the country. All necessary

tools, fixtures, gauges, and testing devices are covered by standard designs, and these standards are specified for use wherever they apply. Such things as scaffolding, temporary lighting, storerooms and job office equipment are also standardized.

The standardization of apparatus greatly facilitates the standardization of packing methods and shipping containers.

The thousands of different items which must be packed and shipped by the Western Electric Company makes the packing problem an extremely important one. In developing standards of packing consideration has to be given not only to the first cost of containers and packing material but also to the serviceability of the package from the standpoint of withstanding abuse in transit, to the convenience with which it may be handled and stored in the Western Electric Company's warehouses and in the Telephone Companies' storerooms, and even, in the case of subscriber's station equipment, to the convenience with which the package may be finally distributed to the subscriber's premises.

When a new method of packing, or a new type of container has proved to be better for a certain item than an existing method, or container, its application to other items is immediately considered; however every effort is made to keep the variety of sizes and shapes of containers at a reasonable minimum.

To assure uniform methods where products are packed at more than one location and to preserve the standard designs, specifications and drawings covering the method and designs are prepared and accumulated in a packing manual.

Standard methods instructions are distributed to the installers in the form of handbooks. Catalogs of standard tools and supplies, giving information as to how and where each item may be obtained are also supplied to the men. The sequence in which apparatus and material can best be used by the installers has been

studied and standard shipping schedules are prescribed to insure that the work may proceed in an orderly manner.

Before a completed equipment is turned over to the telephone company certain standard final tests are applied by the installers to assure its satisfactory performance. This insures that a certain circuit will be tested in the same manner and must meet the same requirements whether installed in New York or on the Pacific Coast.

The procedure and methods for making tests and the testing equipment have been standardized to conform to the standard tests. A number of standard sizes and types of test set containers have also been adopted.

Standardization in Relation to Operation

As a part of the work of the General Departments, the best methods for the construction of telephone plant are worked out, taking account of the experience of all of the Operating Companies. These methods are presented in the form of construction handbooks, which are made available to all of the operating companies through a common source in order to get the advantage of quantity production.

The standard construction practices are based upon the use all over the country of standard types of construction material. This standardization of materials makes it possible for the purchasing organization to buy very large quantities of a relatively small number of types of material with resultant large savings in cost. Also with shifting of needs men engaged in construction work can transfer easily from one part of the System to another. It is common practice, in cases of emergency due to large storm damage or other causes, to temporarily concentrate in one small area construction gangs from a number of different operating companies. These men have no difficulty with the work

in a new area because of the uniform construction practices in use throughout the country. Furthermore, in severe storm emergencies the fact that the material needed has been standardized makes it possible to obtain it quickly in great quantities from the many points where it is stocked throughout the country.

The maintenance practices are standardized in ways similar to those discussed for the construction practices. Bell System maintenance practices are prepared by the general departments, making use of the maintenance experiences of the operating companies and of general investigations of the relative advantages of different practices and methods. These standard practices are printed in quantity and are ordered by the various companies for use as required. In addition to the advantages discussed above for uniform construction practices, there is a further advantage, important from the standpoint of toll service, that men at widely separated points and employed by different companies are using the same practices for the maintenance of telephone circuits and equipment. These men can, therefore, deal with each other at long range effectively without misunderstanding because of their common background of methods and materials.

It is perhaps in considering traffic operating practices that the advantages, and indeed, the necessity of standardization in relation to operation, are most evident in the Bell System. The telephone subscriber has the right to expect the same sort of operating practices in the various cities of the country so that he may use the telephone with a maximum of convenience. In toll calls the operators must constantly deal with other operators in distant cities and employed by different companies, and it is obviously essential that the operating practices should be alike in order to avoid difficulties.

Standard operating practices are developed by the general departments as a result of their studies and investigations, and taking advantage also of the actual

operating experience of the companies. These standard operating practices are used for handling all types of calls with the various types of standard equipment. The practices cover local exchange service in all of its forms, such as flat rate, message rate, coin box, individual or party line service, etc., and also toll and long distance service. They also cover information service and other auxiliary services for calls requiring special treatment.

The practices specify in detail the procedure to be followed by operators in handling these various types of calls, and in general specify also the phraseology to be used by the operators, with a view to insuring maximum accuracy, clearness and convenience to the subscribers.

As operators are constantly entering and leaving the service, it is necessary to carry on continuously schools for the training of new operators. Each Associated Company maintains a Training Department and the methods and equipment used in this training work have been standardized throughout the entire country.

An interesting illustration of the standardization of operating practices is given by the procedure known as the " Service Order Routine " for establishing new or changing existing telephone service. These operations require the co-ordinated effort of all operating departments of the telephone company, including arrangements for installing subscribers' station apparatus and wiring, the placing of outside wires, the inter-connection of apparatus in the telephone central offices and proper designation of the new line at the telephone switchboard, proper tests of completed circuits, arrangements for commencing the furnishing of the traffic service and arrangements for proper billing and entry in the directory and for the advice of information operators. Extensive studies have developed general plans for accomplishing this somewhat complicated service function in the best possible way in a minimum

of time and with maximum insurance that all the necessary steps will be taken without confusion. On the basis of these general plans each operating company develops a specific detailed Service Order Routine which is made standard for that company.

Standardization of Business Methods

A very valuable type of standardization which may be classed under the heading of " business methods " is the standardization of non-technical supplies, particularly of office supplies and furniture. Purchases of the Bell System companies in this line exceed $5,000,000 per year and appreciable savings have been derived by the standardization of these supplies. In addition to the savings, such standardization has resulted in the provision of supplies better suited to company requirements through the analysis by trained specialists, in the determination of the best methods of handling supplies to promote efficiency and reduce waste, and in supervision of the quality of the supplies purchased.

The effect in reduction of costs can be illustrated by the single item of black lead pencils, the purchase of which amounts at the present time to more than $150,000 a year. Prior to standardization fifty-five different brands were in actual use, while at the present time only three types are used, these providing a range of quality, with one of these grades covering 93 percent of all requirements. The saving from standardization of black lead pencils is estimated at $50,000 per year.

Another interesting phase of this work has been the investigation of all clerical labor saving machines, the development of machines best adapted to the needs of the telephone business, and the standardization and use of the types found most advantageous.

In a business as complicated and as widespread geographically as the Bell Telephone System it is highly essential, in order that System reports may reflect accurately the results throughout the country, that a uni-

form classification of accounts be followed throughout. The accounts of the telephone companies in the Bell System have been standardized in accordance with those prescribed by the Interstate Commerce Commission, with certain amplifications which render them more effective for Bell telephone accounting practice and do not impair the integrity of the accounts prescribed. This makes it possible not only to summarize the growth and operation of the System as a whole but also to make significant comparisons of the results achieved by the various operating areas. Without such a system of uniform accounting, the unified and economical operation of the Bell System operating properties would be very greatly hampered.

Accounting practices and methods are studied continuously by specialists in the General Staff organization and improvements in standards which are developed are generally adopted by all the operating companies. Included in the detailed accounting practices which are generally standardized for the Bell System are such items as cost accounting, payroll and vouchering methods, administrative reports and budgetary control methods, inventory control methods and schedules, auditing methods, application of mechanical devices to accounting work, and many other similar matters which lend themselves to standardization resulting in increased economies and efficiency..

One of the routine accounting jobs which lends itself to standardization is that of keeping the accounts of customers and rendering bills for service. The value of standardization for this routine work is readily seen in that in the Bell System, accounts are kept with approximately 11,000,000 customers and more than 125,000,000 bills for exchange service are rendered each year. More than one billion and a quarter charge tickets are handled annually in order that charges for service may be properly made against telephone users. Nine hundred million of these charge tickets are for

toll service, of which 750,000,000 must be entered separately on approximately 71,000,000 toll service statements.

For the keeping of accounts there has been developed and made standard what is known as the "accounting stub plan." In this plan, stubs which form a part of the bills are detached when bills are mailed and take the place of ledger or card records of the accounts.

For many years the preparation of bills and statements as to name, address and exchange service charges has been facilitated by the use of standard addressing equipment.

Rendering such a vast number of bills on a monthly basis brought about a very uneven distribution of work with a peak load at the beginning of each month, and to overcome this difficulty what is known as 'rotation billing' was introduced. Under this plan each accounting office divides its accounts into six groups and for each group bills are rendered at different dates at five-day intervals during the month. This permits of spreading the load over the entire month.

Along with the improvements in the practices referred to there has been a continuous development of machinery and other labor saving devices in connection with rendering customers' bills. To enter 750,000,000 toll charge tickets on approximately 71,000,000 toll service statements presented a most fertile field for the realization of economy through the development and standardization of mechanical devices. A standard form of statement for toll billing was developed and studies were made in conjunction with leading manufacturers of typewriters for devising a billing machine of special construction adapted to this particular work. After the machine was developed and exhaustively tested under careful observation it was made standard for Bell System use and has been adopted by all of the companies.

The standardization of practices, particularly the two referred to as " accounting stub plan " and " rotation billing plan," has made possible and practicable the standardization of specially constructed mechanical equipment (in addition to the toll billing typewriter referred to above) for the preparation of customers' bills which has been recommended for Bell System use. This equipment eliminates all handwriting from customers' bills and produces a more accurate bill than was possible under any other plan together with improved general appearance of bills. None of these standardized billing practices imposes unnecessary restrictions or complications upon the employees in the handling of business affairs with customers. Exception practices are provided so that the wishes of a customer desiring to be billed in a manner different from the standard or at other than prescribed billing periods may be given due consideration.

Telephone directories have offered an important field for standardization in spite of the fact that no two directories are entirely alike. The paper and cover stock used are standardized and purchased centrally through the Western Electric Company and manufactured in accordance with specifications and the supply checked continuously for quality. The general arrangement of material in the book is standard, standard alphabeting rules are followed in listing names, standard page sizes used, standard sizes of space offered for advertising and standard types used in printing. In the clerical work of compilation, standard practices are followed. From this standardization have resulted not only a uniformity in appearance and ease of reference, but large economies in compilation and manufacturing cost. It is estimated that without the standardization of directory paper and the bulk purchasing which this enables, the same quality of paper would cost the Bell System about $800,000 more per year.

Standard Provisions for Safety and Health

The plant of the Bell System is constructed to conform to definite standards as regards strength of construction. In the formulation of these standards, consideration is given to the safety of the employees and the public, as well as to the continuity of service.

The question of safety is most important in cases where other wire lines or railroads also are involved. Standard requirements regarding type and strength of construction have been established for all such cases in co-operation with the other utilities involved. Many of these requirements are set forth in the National Electrical Safety Code. Experience shows that such construction standards greatly increase the safety of workers on telephone lines.

Safety is considered not only in the initial construction but also in the standard provisions for routine maintenance which call for maintaining suitable margins of strength in plant which is in proximity to other wire lines.

Very definite provisions have been made for protecting the public, the employees and property against electrical hazards. As a result of co-operation between the power and telephone companies standard provisions have been adopted to reduce the chance of power voltages or currents being introduced into any part of the telephone plant. These rules specify standards of strength and of separation, and the relative location of pole lines, wires and outside equipment when placed on the same poles, or in proximity.

Supplementing these precautions as regards power circuits, and as a provision against damage due to lightning, standard installations of protective apparatus are provided for subscribers' and central office equipment and for cables when the wires are exposed to these hazards. The use of standard arrangements throughout the country insures a uniform, high degree of safety to the users of the telephone plant.

Protection against fire is, of course, a very important consideration, particularly in the planning of buildings. Next to the safety of personnel, continuity of service is a main objective. All telephone buildings, except for certain small offices, are made fire resistive, the construction conforming to the standards of the National Board of Fire Underwriters for fire resistive buildings. The most approved fire resistive devices are used, such as metal and wire glass windows, hollow steel doors, extra strong partitions enclosing shafts and exits, and rolling steel shutters for openings facing hazardous exposures. In addition, very complete fire fighting appliances are provided in all buildings. Additional methods and devices are adopted by the companies in accordance with the recommendations of the Underwriters and as the result of investigations carried out by the headquarters' departments.

Standard equipment has been developed for both outside construction forces and manufacturing forces with a view to safety as well as efficiency. These developments include such things as linemen's safety straps, standard goggles for protection from dust and others for protection from heat, etc.

In the factories, standardized methods of safeguarding machines have been adopted that make it simple to guard new equipment and furnish a criterion for determining whether or not equipment is properly guarded. Because these standards have been tried in other installations, it can be confidently concluded that guards made in accordance with their requirements will not fail to afford maximum protection. Without such standards it would be necessary to design guards individually for each installation with the danger that the use of untried designs might result in unforeseen accident hazards. Standardized practices are followed in the provision of ventilators and dust removing devices, resulting in assured safety to the workers and in reduced cost of design.

A great deal of attention has been given to the development of standard safety provisions for the outside construction forces. In this standardization, groups of construction employees directly involved play an outstanding part. This procedure has the great advantage of developing the initiative and judgment of the employees themselves who are, in the last analysis, directly responsible for the effectiveness and use of any safety standards adopted. The results of studies of these groups with the co-operation of representatives of the general departments are issued as Safety Codes adopted as standard by each of the operating companies.

In view of the importance of these standards to all employees, various methods are used to insure the maximum degree of publicity. Illustrated articles are published in the company magazines. Posters showing safe methods of performing work or hazardous practices to be avoided are displayed each month by the operating companies.

First aid activities have been standardized with respect to the subject matter to be taught, the methods of teaching, and the first aid equipment provided. All companies use a textbook prepared by the American Telephone and Telegraph Company in co-operation with the American Red Cross. For the use of new employees who have not yet received formal instruction in First Aid practices, a small handbook is available containing terse directions for the treatment of the more common injuries. Through further collaboration with the Red Cross all instructors are thoroughly trained in standard first aid practices. Two first aid kits have been standardized, the larger for group use and the smaller for individual use.

Standard provisions are followed throughout the System with regard to the physical environment under which the telephone operating forces perform their duties with a view to providing the most healthful con-

ditions. These standards relate to light, heat, ventilation, rest rooms, lunch rooms, etc.

Co-operation with Outside Standardizing Bodies

Reference has been made from time to time in the above discussion to co-operation with outside standardizing bodies. While a very large part of the standardizing work of the Bell System is of interest in connection with its own activities alone, some of this work is of general interest and the System is co-operating in these cases with the other organizations interested for the purpose of developing standards of more general application.

The extent of this co-operative work with other organizations is illustrated by the following items:

American Standards Association

The Bell System co-operates with the United States Independent Telephone Association in the formation of the telephone group which has three representatives on the American Standards Association. The telephone group is co-operating in twelve standardizing projects under the auspices of this committee.

American Institute of Electrical Engineers

Two of the members of the Standards Committee of the A. I. E. E. are from the Bell System which is also co-operating in the work of three working committees.

American Railway Association

Representatives of the Bell System are co-operating in eleven committees engaged in standardization work relating to communication and allied problems.

Institute of Radio Engineers

Three Bell System men are members of the Standards Committee of this organization.

American Society for Testing Materials

The Bell System has representatives on many of their technical committees working on standard methods of tests and specifications, including those for nonferrous metals, insulating materials, magnetic materials, protective coatings, etc.

National Electric Light Association

The Bell System has formed with the N. E. L. A. a joint general committee for the purpose of developing mutually acceptable standards for the physical relations between lines of power companies and telephone companies when they are in proximity to each other, with particular reference to safety, joint use of poles and inductive co-ordination.

International Electrotechnical Commission

The Bell System has three representatives on the United States National Committee of this Commission.

The above reference to some of the principal standardizing projects in which the Bell System is co-operating with other bodies is not at all inclusive but indicates in a general way the scope of this work.

Conclusion

The above general outline of standardizing activities in the Bell System is sufficient to indicate the outstanding part which standardization has played in the building up of the Bell System. For many years, standardization based upon not only the present needs of the telephone system but also the best picture obtainable of future trends, has been an integral part of the program of development of telephone service. One type of standardization increases both the possibility and the advantages of another type so that in such an organiza-

tion, standardization activities ramify through the entire structure and touch every part of the work.

The total economies resulting from standardization, of course, it would be impossible to closely estimate. Standardization as indicated above, has been productive of many advantages in addition to economy. The advantages from standardization may be summarized as follows:

1. Standardization makes the best available for all.
2. Standardization reduces the cost because, when all companies use the same things, they can be manufactured in the largest quantities and uniformity in output contributes to economies in production.
3. Standardization reduces the cost of carrying stocks of materials and the cost of maintenance and repairs, because fewer parts have to be carried and maintained.
4. Standardization reduces the cost of instruction of new employees because there are fewer things with which to get acquainted.
5. Standardization reduces accounting costs because there are fewer types and sizes of materials to keep track of.
6. Standardization minimizes complicated engineering and operating problems that might result from intercommunication between widely divergent systems and apparatus.
7. Standardization renders available large supplies of materials and labor in emergencies.
8. Standardization greatly facilitates development work, since improvement in, or development of, a new article involves a co-ordination with a smaller number of associated parts.

H. S. Osborne.

Abstracts of Technical Papers from Bell System Sources

The Receiving System for Long-wave Transatlantic Radio Telephony,[1] by Austin Bailey, S. W. Dean, and W. T. Wintringham. Transmission considerations and practical limitations indicate that in the lower frequency range, frequencies near 60 kc are best suited for transatlantic radio-telephone transmission. A radio receiving location in Maine gives a signal-to-noise ratio improvement over a New York location equivalent to increasing the power of the British transmitter about 50 times.

Various types of receiving antennas are briefly discussed. The wave antenna is selected as being most suitable for long-wave radio telephony. The various factors affecting wave antenna performance and methods for measuring the physical constants of wave antennas are discussed in detail. High-frequency ground conductivities determined from wave antenna measurements are given. Combination of several antennas to form arrays is found to be a desirable means of decreasing interference. The use of a wave antenna array in Maine decreases the received noise power by an additional 400 times. If the receiving were to be accomplished near New York using a loop antenna, we would have to increase the power of the British transmitting station 20,000 times to obtain the same signal-to-noise ratio. Comparisons of calculated and observed directional diagrams of wave antennas and wave antenna arrays are presented and discussed.

The transmission considerations governing the design of a radio receiver for commercial telephone reception are outlined.

[1] Proc. of I. R. E., December, 1928, pp. 1645–1705; Bell System Technical Journal, April, 1929.

Mathematical discussions of the wave antenna, antenna arrays, quasitilt angle, and probability of simultaneous occurrence of telegraph interference are given in the appendices.

Electrons and Quanta,[2] by C. J. Davisson. The experiments by the author and L. H. Germer, by G. P. Thomson and by others from which the wave properties of electrons are adduced are briefly described. The agreement between the results of these experiments and the prediction of L. de Broglie is pointed out. The wave and corpuscular properties of electrons are compared with the similar properties of light quanta.

Contemporary Advances in Physics, XVIII. The Diffraction of Waves by Crystals,[3] by Karl K. Darrow. This is an elementary introduction to the phenomena of diffraction of waves by crystals, one of the most striking and important discoveries of the last twenty years of physics. These phenomena have proved that X-rays and electrons are partly of the nature of waves, and have supplied the best available methods of measuring their wave-lengths; while on the other hand, the study of the diffraction-pattern of a crystalline substance makes it possible to determine the arrangement and the interrelations of the atoms with a precision and fullness heretofore unimagined, which promises and has already yielded knowledge of the greatest value in all the fields of science.

Purified Textile Insulation for Telephone Central Office Wiring,[4] by H. H. Glenn and E. B. Wood. This paper outlines methods by which silk and cotton insulation can be purified and improved. It gives the results

[2] Bell System Technical Journal, April, 1929. Presented at the Michelson Meeting of the Optical Society, Washington, D. C., November 1–3, 1928.

[3] Bell System Technical Journal, April, 1929.

[4] Bell System Technical Journal, April, 1929. Presented at the Winter Convention of the A. I. E. E., New York, N. Y., Jan. 28–Feb. 1, 1919; Abridgment published in A. I. E. E. Journal, February, 1929, p. 146.

of tests on the insulation properties of these materials before and after purification and explains the testing procedures. One of the findings is that the purified cotton may be substituted for ordinary commercial silk.

Effect of Signal Distortion on Morse Telegraph Transmission Quality,[5] by J. Herman. In applying telegraph transmission measuring apparatus to the development and maintenance of telegraph circuits, it is desirable to correlate quantitative measurements of telegraph signal distortion with quality of telegraph transmission. Accordingly, a series of tests has been carried out in order to determine this relationship for the case of manual operation using the American Morse Code. These tests are described and the results, together with the conclusions reached, are given in summarized form.

A Braun Tube Hysteresigraph,[6] by J. B. Johnson. In this paper apparatus for observing hysteresis loops of magnetic materials is described. It combines a cathode ray oscillograph with a vacuum tube amplifier and an electrical integrating circuit consisting of condenser and resistance. The device describes the B–H curve for alternating magnetization in the frequency range of five to perhaps several thousand periods per second. The specimens may be either long strips or closed rings. Alternating flux as low as one maxwell may be readily observed.

The operation of the apparatus is analyzed so as to account for the effects of finite time constants of the amplifier and integrator, of conductance in the condensers, of demagnetization by current in the search coil and by the stray fields of coils and specimen, and of eddy currents in the specimen.

[5] Bell System Technical Journal, April, 1929.
[6] Bell System Technical Journal, April, 1929.

Oscillographs for Recording Transient Phenomena.[7] by W. A. Marrison. In this paper oscillographs developed for recording transient phenomena are described which obtain automatically records of amplitude, wave form, frequency, duration, and time of any electrical disturbance for which they are adapted. Two instruments are described for recording very short or very long transients; these may be used in combination. At power frequencies satisfactory records may be made on film or sensitized paper with a two-watt lamp. The instruments and their performance are illustrated by photographs and oscillograms.

Telephone Apparatus Springs.[8] *A Review of the Principal Types and the Properties Desired of These Springs,* by J. R. Townsend. This article describes the types of springs employed in telephone apparatus and enumerates the engineering requirements both from the standpoint of mechanics and the quality of materials desired. The chemical and physical requirements of the spring materials are given. The importance of fatigue is emphasized and the endurance limit is given for spring brass, nickel silver and phosphor bronze.

The Predominating Influence of Moisture and Electrolytic Material Upon Textiles as Insulators,[9] by R. R. Williams and E. J. Murphy. The insulating qualities of textiles vary with the amount of moisture present in them from hour to hour and are also strongly influenced by the amount of electrolytic material (salts, etc.) which the textiles contain. Electrolytic material may be washed out producing a commercially realizable in-

[7] Bell System Technical Journal, April, 1929. Presented at the Regional Meeting of the Middle Eastern District of the A. I. E. E., Cincinnati, Ohio, March 20–22, 1929.

[8] Bell System Technical Journal, April, 1929. Presented at the Annual Meeting, New York, N. Y., Dec. 3 to 7, 1928, of The American Society of Mechanical Engineers, 29 W. 39th Street, New York, N. Y.

[9] Bell System Technical Journal, April, 1929. Presented at the Winter Convention of the A. I. E. E., Jan. 28–Feb. 1, 1929.

crease in insulation resistance of the order of 50 times the original value.

The resistance of the animal fibers, silk and wool, is far greater for a given moisture content than that of cotton or of cellulose acetate, a derivative of cotton. It appears probable that the distribution of water as well as the quantity is important and that the two classes of fibers are characterized by different space patterns according to which the water is distributed. It is suggested that the space distribution patterns are associated with the colloidal structures of the materials and in turn with their chemical classification as proteins and celluloses respectively. Cellulose acetate absorbs little water as compared with cotton and is correspondingly superior electrically. However its resistance varies with moisture content in the same way as that of cotton.

Scattering of Quanta with Diminution of Frequency,[10] by Karl K. Darrow. In this article the author points out that certain phenomena of X-rays recently reported were illustrations of the general process of scattering of light with change in frequency, which had just begun to attract attention owing to important observations made by Raman and others with visible and ultra-violet light. The content was amplified and restated in Dr. Darrow's article entitled " Contemporary Advances in Physics, XVII—The Scattering of Light with Change of Frequency," which appeared in the January, 1929, issue of the *Bell System Technical Journal.*

Dissociation of Molecules as Disclosed by Band-Spectra,[11] by Karl K. Darrow. This lecture was a contribution to a Symposium on Atomic Structure of the American Chemical Society. It is an elementary account of the way in which the band-spectra of molecular gases are interpreted so as to disclose the laws and de-

[10] Science, Vol. 68, November 16, 1928, pp. 488–490.
[11] Chemical Reviews, Vol. V, December, 1928, pp. 451–466.

tails of the dissociation of their molecules into atoms, a process of great scientific and some practical importance.

Using Inspection Data to Control Quality,[12] by H. F. Dodge. This paper outlines a method of using inspection data to improve the technique of controlling at economic levels the quality of product in the various stages of manufacture. Essentially, the method rests on the application of statistical methods of analysis, employing the viewpoint that every batch of manufactured product constitutes a sample from a much larger universe and as such is subject to random of chance variations in quality. The variations in quality as observed in inspection data may thus be the result of either chance causes or of fundamental production causes whose presence is undesirable.

Speech and Hearing,[13] by Harvey Fletcher. This book is concerned mainly with the results of Bell System research work on speech and hearing. These results, however, can be understood and appreciated better when their relationship to similar work is shown. Consequently, copious references to the experimental results of other workers have been included. The material is grouped under four headings: (1) Speech, (2) Music and Noise, (3) Hearing, and (4) Perception of Speech and Hearing.

The first part is concerned with the mechanism of speaking, the classification of the fundamental English speech sounds, and with the wave forms of such sounds. It includes a description of various types of apparatus which can be used for making permanent records of speech waves and gives a large number of accurate wave pictures of the speech sounds together with the power contained in such waves.

[12] Manufacturing Industries, Vol. XVI, November, 1928, pp. 517–519, and December, 1928, pp. 613–615.

[13] D. Van Nostrand Co., Inc., New York, 1929.

In the second part similar data are given for musical sounds and noise.

The third part begins with a discussion of a theory of hearing which is proposed to explain the experimental facts of audition. This is followed by a discussion of the known facts of audition such as the limits of audition, the minimum perceptible differences in sound, masking effects, binaural effects, methods of testing the acuity of hearing, etc. Along with this discussion is given a description of the apparatus and experimental methods used for determining these facts.

The fourth part is concerned with those phases of the subject that involve personal judgment, that is, the psychological element. A scale for measuring the loudness and the pitch of complex sounds is defined. Experimental data are given which show how these two subjective quantities depend upon external physical quantities. Methods of measuring the recognition of speech sounds are described and experimental results using such methods are given to show the effect of various types of distortion upon the ability of persons to recognize such distorted sounds.

Elementary Differential Equations,[14] by Thornton C. Fry. In this book Dr. Fry has covered the field of differential equations as usually offered in elementary courses in universities and technical schools. The mathematical ideas are first presented as mathematical entities in themselves and not as the symbolic formulation of physical concepts. With this accomplished, these ideas are broadened and illustrated by live scientific examples and problems, which are drawn from a wide variety of fields. The inclusion of such technical material does not presuppose a wider knowledge of technical subjects than the reader can reasonably be expected to possess, nor does it interfere with the clarity of the mathematical presentation.

[14] D. Van Nostrand Company, Inc., New York, 1929.

Optical Conditions for Direct Scanning in Television,[15] by Frank Gray and Herbert E. Ives. This paper discusses the conditions for securing the maximum amount of light in a photoelectric cell placed behind a television scanning disc when an image is formed on the disc by a lens. Results obtained with a large scanning disc and a lens forming images of sunlit objects are described.

A Camera for Making Parallax Panoramagrams,[16] by Herbert E. Ives. This paper describes a camera for making transparencies which when viewed through an opaque line grating show stereoscopic relief through a wide range of distances and angles. The essential feature of the camera is a mechanical coupling by means of which the camera lens, the sensitive plate and grating, and the object photographed, are kept in line as the camera moves from one side to the other of the normal from the camera track to the object.

European Factory Methods and Equipment in the Manufacture of Metals,[17] by David Levinger. In this paper the author outlines his observations of the metal-working industries of Europe, based on a three months' tour of eight countries during the summer of 1927, in which seventy-five industrial establishments were visited in England, France, Germany, Belgium, Holland, Italy, Austria and Switzerland.

Electrical Conduction in Textiles. Part I—The Dependence of the Resistivity of Cotton, Silk and Wool on Relative Humidity and Moisture Content,[18] by E. J. Murphy and A. C. Walker. The data reported show that the resistivity of cotton is about 10^{12} times greater

[15] Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 17, December, 1928, pp. 428–434.

[16] Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 17, December, 1928, pp. 435–439.

[17] Mining and Metallurgy, Vol. 9, November, 1928, pp. 483–486.

[18] Journal of Physical Chemistry, Vol. 32, December, 1928, pp. 1761–1786.

at 1 percent humidity than at 99 percent, that is an exponential function of relative humidity in the range 20–80 percent and a power function of moisture content over the whole range investigated. By means of the equations expressing these relationships the resistance of a cotton sample can be calculated for any moisture content (or the relative humidities corresponding to it) provided a measurement has been made at a single moisture content. The curves for the logarithm of resistance vs. relative humidity (or moisture content) for samples of cotton containing different amounts of electrolytic material are parallel, low electrolyte content corresponding to high resistance. Similar but less extensive measurements were made on silk and wool. The results indicate that the conductivity of a textile is practically completely determined by three factors, the amount of absorbed water, its specific conductance (as determined by the amount of electrolytic material present in the textile) and its distribution.

The Effect of Gases on the Resistance of Granular Carbon Contacts,[19] by P. S. Olmstead. This paper describes a method whereby reproducible measurements of the resistance of granular carbon contacts can be made. The experimental arrangements were such that the resistance could be measured as a function of gas pressure, applied voltage, or time.

Note on the Determination of the Ionization in the Upper Atmosphere,[20] by J. C. Schelleng. This paper describes a method of estimating the distribution of ionization in the upper atmosphere, based upon measurements of the effective height determined by interference or echo experiments. These two types of experiment are shown to give identical results.

[19] Journal of Physical Chemistry, Vol. 33, January, 1929, pp. 69–80.
[20] Proceedings of the I. R. E., Vol. 16, November, 1928, pp. 1471–1476.

Lead-Tin-Cadmium as a Substitute for Lead-Tin Wiping Solder,[21] by Earle E. Schumacher and Edward J. Basch. In this paper data are presented which show the certain lead-tin-cadmium alloys may be advantageously substituted as solders for lead-tin alloys. Data are given showing the physical and chemical properties of these alloys.

New Specifications for Raw Materials,[22] by J. R. Townsend. In this article the author points out that the annual demand for new telephone apparatus by the Bell System requires a steady flow of materials of the proper quality and uniformity into its manufacturing plants. To meet this demand, a new set of engineering specifications has been inaugurated to control these raw materials. A notable example of this specification work is the preparation of Rockwell hardness and tensile strength requirements for sheet brass, nickel silver and phosphor bronze. The Western Electric Company, the Northern Electric Company and one of the suppliers, the American Brass Company, co-operated in this work. Rolling series were prepared covering all grades, thicknesses and tempers. The requirements were based on the data furnished by producer and consumer, and on experience over a long period with commercial material.

[21] Industrial and Engineering Chemistry, Vol. 21, January, 1929, pp. 16–19.
[22] Instruments, Vol. 1, December, 1928, pp. 519–521.

Notes on Recent Occurrences

NEW TOLL AND LONG DISTANCE RATES EFFECTIVE FEBRUARY 1 REPRESENT THIRD REDUCTION IN 28 MONTHS

A REDUCTION in day rates for toll and long distance telephone calls was made effective February 1 which will represent a saving to the customers annually of more than $5,000,000. This reduction, the third in a little more than two years, cuts from $.05 to $.25 from charges for station-to-station calls between points from 130 to approximately 1,500 miles apart. Middle distance rates received reductions as high as 13 per cent. An equivalent rate reduction was made for person-to-person service. Evening and night rates remain at their former level. For a call from New York to Chicago the basic station-to-station day rate was reduced from $3.25 to $3.00. A New York-Palm Beach call or one between Denver and San Francisco now costs $3.75 instead of $4. Separate rates for appointment and messenger service under the new schedule are eliminated, these services being offered at regular person-to-person rates. The extra charges above person-to-person rates previously made for appointment and messenger calls are eliminated for all long distance calls so that these calls are now charged at person-to-person rates.

A little more than a year ago, President Walter S. Gifford addressed the National Association of Railroad and Utilities Commissioners, at which time he defined the fundamental policy of the Bell System as that of furnishing the best possible service at the lowest cost consistent with financial safety. This is the second substantial saving to be offered its customers by the Bell System since that address, and is further concrete

evidence of the way in which the policy operates. The previous rate reduction, effective December 1, 1927, which immediately followed this definition of policy and saved the telephone users $1,500,000 in 1928 alone, largely concerned calls to more distant points. Another such rate reduction, representing an estimated saving to the telephone users of $3,000,000, went into effect on October 1, 1926.

The increasing reliance of the American public upon telephone circuits between far-flung points as a business and social necessity has combined with further improved devices and methods developed by the Bell System, to effect the economies that make possible this latest lowering of rates.

GENERAL SALES CONFERENCE

THE General Sales Supervisors of the Bell System met in New York City for the first System Sales Conference January 28 to February 2, inclusive. The Conference was attended by 48 representatives from the Associated Companies, the Long Lines Department of the American Company and the Bell Telephone Company of Canada and also by various officials and members of the Headquarters Staff in New York. H. C. Lauderback, Sales and Development Engineer of the A. T. and T. Co., presided throughout the Conference.

The work of the Conference was divided into five general groups:

1. Exchange Sales.
2. Toll Sales.
3. Organization and Personnel Problems.
4. Sales Information and Advertising.
5. Customer Relations.

The various subjects were presented in papers prepared by both Associated Company and A. T. and T. Company representatives, with the Associated Com-

pany representatives presenting the greater number of subjects.

Particular stress was laid upon the importance of maintaining sales work in its proper relationship to overall telephone operations. Our motive should be not to sell all of the service that can be sold—but to sell only the service which, in the judgment of the management, it is good business to sell at the time, considering all of the circumstances.

It was developed that the formulation of sales plans having definitely in mind the particular phases of operation which each type of sales activity was intended to improve, should be helpful in securing the best possible direction of sales effort. Accordingly the discussion of Exchange Sales Planning was directed and results information presented under the following headings: Planning to Improve Subscriber Service, Planning to Utilize Idle or Spare Plant, Planning to Utilize Rate Schedules most Effectively, Planning to Promote a Greater Use of the Service. Discussion of Exchange Sales Activities was divided into such subjects as Participation of all Departments in Sales Work, Stimulated Sales in the Business Office, Obtaining New Subscribers, Regrading Activities, Sale of Auxiliary Services and By-Product Service, Sale of Public and Semi-Public Services, Sales to Promote Convenient Telephone Service in Homes and Commercial Service Activities. The presentation of the general subject of Toll Sales Planning was followed by discussions of Toll Sales Activities including Sales to Promote a Greater Use of Toll Service among Business Subscribers, Sales to Promote a Greater Use among Residence Subscribers and the Key Town Plan of Selling by Telephone.

President J. S. McCulloh of the New York Telephone Company welcomed the conference to the Headquarters' Building of the New York Company at 140 West Street, where the conference was held.

Vice President A. W. Page addressed the conferees on the close relationship existing between sales activities and the work of the Information Departments. R. H. Burcher discussed phases of plant operation affecting sales activities. H. H. Carter, General Commercial Manager, Long Lines Department, outlined the sales plans and activities of that Department. Improvements in traffic operation and their effect on exchange and toll development as indicated in past performance were discussed by A. J. Allen. Equipment problems, including the provision of new instrumentalities, were presented by W. H. Harrison.

L. B. Wilson was present at all sessions of the Conference, and addressed the Conference on various phases of commercial operation. C. Wallace, H. H. Shearer, and Z. Z. Hugus presented the rate, directory, and employee training aspects of sales activities. Visitors to the conference included W. J. O'Connor, T. T. Cook, H. E. Darling of the New England Company, Southern Area, M. B. Downing, A. D. Welch, W. A. Kietzman, and K. S. McHugh of the New York Telephone Company, F. M. McEniry, Wisconsin Telephone Company, and F. M. Hoag of the Southwestern Bell Telephone Company.

Emphasis was given throughout the Conference to the Customer Relations Aspects of Sales Activities and the general conception of Sales Activities as a means of rounding out and perfecting the communication facilities of customers.

CONFERENCE OF BELL SYSTEM EDITORS

A CONFERENCE of editors of the employee magazines published by Bell System operating companies, the Western Electric Company and the Bell Telephone Laboratories was held at 195 Broadway, February 25th to 28th, inclusive. It was the first separate conference of the editors as a group, their pre-

vious meetings having been as members of general publicity conferences. The general theme of the discussion was the function of the System magazines in stimulating and maintaining the *esprit de corps* of telephone men and women. Addresses were made during the conference by President W. S. Gifford, and Vice Presidents A. W. Page, E. K. Hall and B. Gherardi.

TRANSATLANTIC SERVICE TO LUXEMBURG

AMERICAN telephone users were enabled to reach directly one of the smallest independent European states on and after March 1, when transatlantic telephone service was extended to include the City of Luxemburg, capital of the Grand Duchy of Luxemburg. The rate for a telephone conversation from New York is $48.00 for the first three minutes and $16.00 for each additional minute.

The Duchy is smaller than Rhode Island. It has a population of 270,000, served by 9,000 telephones. The City of Luxemburg numbers 50,000 inhabitants.

BELL LINES USED FOR INAUGURATION BROADCASTING AND TELEPHOTOGRAPHS

THE Bell System had an important part to play on March 4 during the inauguration of President Hoover and Vice-President Curtis. More than 30,000 miles of telephone program circuit carried the inaugural ceremonies to 118 radio stations in all parts of the country, making the occasion the largest chain broadcast which has ever occurred. By means of a number of pick-up circuits furnished by local loops from the various points where events connected with the inauguration took place, complete descriptions of all the occurrences of the day were supplied to the listening public. During the lunch hour in Washington, President Hoover listened to a program of celebration from his home town, Palo Alto, California, brought east over

one of the transcontinental circuits. Pictures of the inauguration were sent to newspapers throughout the country through a special telephotograph station established temporarily at Washington.

Radio Broadcasting Networks

Microphones were located at the White House, the Senate Chamber, the east steps of the Capitol, the Peace Monument, on Pennsylvania Avenue near the Capitol, the Treasury Building, and at other points. The broadcasting companies also had facilities in aircraft above the route of the inaugural parade and sent out the reports of observers overhead. The broadcast of the vice-presidential ceremonies in the Senate Chamber was of special interest since this was the first time this has taken place, a regulation previously preventing the placing of wires in the Senate Chamber. Local public address systems were in operation at the east steps of the Capitol and also at the reviewing stand at the White House, and enabled great audiences to hear the proceedings.

All of the radio stations regularly on broadcasting networks were furnished service on this occasion along with a number of special additions. The larger broadcasting companies had coast-to-coast circuits, and their programs were available to practically every radio listener in the country. The exercises were also heard by many listeners in distant countries through high frequency short-wave transmission from various stations. It was reported that one of these transmissions was successfully received in the Hawaiian Islands and re-transmitted over the ordinary broadcasting facilities.

Telephotograph Facilities

A telephotograph station was temporarily installed in Washington to handle pictures of the inauguration. Beginning the evening before the ceremony, this office,

located in the quarters of the Chesapeake and Potomac Telephone Company, transmitted thirty-two photographs, of which about half were sent to all eight stations on the telephotograph circuit, namely: New York, Boston, Cleveland, Chicago, St. Louis, Los Angeles, San Francisco and Atlanta. The views were then sent out by messenger, airplane, etc., so that news agencies and newspapers all over the United States were able to utilize these first pictures of the change of administrations. A force of men from the Long Lines telephotograph, commercial and plant departments took charge of the installation.

Commenting on the telephotograph service in connection with the inauguration, the *New York Evening Post* said editorially:

> "It was an interesting fact that the telephotographs served to the *Post* by Pacific and Atlantic Photos, Inc., came to this office with the speed and precision of the news of the day. They were in this office almost as quickly as the written words sent over the telegraph wires."

Surpasses Previous Inaugurations

The completeness of the radio description, the many millions of listeners who heard the ceremonies, and the transmission of pictures by wire to distant cities, make a vivid contrast with 1917 when the late President Wilson was inaugurated the second time. On this occasion there was neither a public address system nor radio broadcasting. The inauguration of President Harding in 1921 was the first at which the audience had the benefit of a public address system. In 1925 twenty radio stations transmitted the inaugural ceremonies and 20,000,000 persons, it is estimated, heard Calvin Coolidge take the oath at the beginning of his four-year term. Estimates of the number of listeners to the Hoover inauguration run far higher.

ANNUAL MEETING OF STOCKHOLDERS

At the annual election of directors by the stockholders of the American Telephone and Telegraph Company on March 26, Charles Francis Adams, now Secretary of the Navy, and Edwin Farnham Greene retired from the Board. To fill these vacancies, and the vacancy caused by the death of John I. Waterbury, the stockholders added to the Board Thomas Nelson Perkins of Boston, Owen J. Roberts of Philadelphia, and Myron C. Taylor of New York. The remaining sixteen directors were reelected.

The stockholders voted in favor of an increase in the authorized capital stock from $1,500,000,000 to $2,000,000,000. There were 8,616,201 shares voted in favor and 8 shares voted against.

NEW DIRECTORS OF THE A. T & T. CO.

AT its meeting on February 20th, the board of directors of the American Telephone and Telegraph Company elected John W. Davis a director to fill the vacancy caused by the death of Charles E. Hubbard. Mr. Davis, who was Democratic nominee for President in 1924, is a member of the law firm of Davis, Polk, Wardwell, Gardiner & Reed, of New York City. He is also a director of the National Bank of Commerce and a trustee of the Mutual Life Insurance Company.

Thomas Nelson Perkins, who was elected a director on March 26, is a member of the Boston law firm of Ropes, Gray, Boyden and Perkins. He is vice president of the Railway and Light Securities Company, a director of the Merrimac Chemical Company, director and chairman of the Executive Committee of the Puget Sound Power and Light Company and a director and member of the Executive Committee of the Boston and Maine Railroad. During the World War he was a member of the Priorities Committee, chief counsel for the War Industries Board, member of the American

Commission to the Inter-Allied War Conference at Paris, assistant to Secretary of War and assistant director of munitions. He is a fellow of Harvard College.

Owen J. Roberts, who was also elected a director on March 26, is engaged in the practice of law at Philadelphia, as a member of the firm of Roberts and Montgomery. He is a director of the Bell Telephone Company of Pennsylvania, the Real Estate Title Insurance and Trust Company, the Franklin Fire Insurance Company and the Equitable Life Assurance Society of the United States. During the war Mr. Roberts was appointed special deputy attorney-general to represent the United States Government in the prosecution of certain cases and he also represented the United States Housing Corporation in Philadelphia.

The third new director elected on March 26 is Myron C. Taylor, who is chairman of the Finance Committee of the United States Steel Corporation, president and director of Myron Taylor and Company, Inc., and director of the First National Bank of New York, the New York Central Railroad Company, and the Lehigh and Wilkes-Barre Corporation. He is a director and member of the Finance Committee of the Atchison, Topeka and Santa Fe Railway Company and a trustee and member of the Finance Committee of the Mutual Life Insurance Company of New York.

Organization Changes

Chesapeake and Potomac Telephone Company

M. D. Sedam elected Vice-President.

Entered employ of the Bell System as Directory Clerk, Central Union Telephone Company, Indianapolis, 1903; Service Inspector, February, 1904; Chief Clerk and Service Manager, May, 1904; Chief Clerk and Manager, December, 1904; Toll Chief Operator, 1904; District Chief Operator, 1905; Special Agent, Pacific Telephone and Telegraph Company, San Francisco, 1907; City Chief Operator, 1907; Division Superintendent of Traffic, Los Angeles, August, 1908; Traffic Superintendent, Southern California Telephone Company, May, 1917; Division Superintendent of Traffic, Pacific Telephone and Telegraph Company, San Francisco, October, 1919; General Superintendent of Traffic, Chesapeake and Potomac Telephone Company, Washington, D. C., February, 1922; General Traffic Manager, June, 1924; General Manager, May, 1927; Vice-President, February, 1929.

Pacific Telephone and Telegraph Company

R. H. Marwick appointed General Plant Manager, Southern California Area.

Entered employ of the Bell System as Assistant Engineer, New York Telephone Company, Brooklyn, N. Y., April 8, 1911; Engineer, June, 1912; Supervising Foreman, May, 1915; Engineer, June, 1915; District Plant Engineer, August, 1916; Engineer, American Telephone and Telegraph Company, New York City, September, 1920; District Plant Engineer, New York Telephone Company, Brooklyn, December, 1922; Outside Plant Engineer, Southern California Telephone Company, Los Angeles, August, 1924; Division Plant

Manager, February, 1928; General Plant Manager, Pacific Telephone and Telegraph Company, Southern California Area, January, 1929.

I. F. Dix appointed Assistant to General Manager, Oregon-Washington-Idaho Area.

Entered employ of the Bell System as Engineer, New York T. & T. Co., Newark, N. J., 1904; District Engineer, 1907; Division Plant Chief, Pacific Telephone and Telegraph Company, Los Angeles, 1909; Division Plant Engineer, 1911; Plant Engineer, Southern California Telephone Company, May, 1917; Plant Superintendent, January, 1919; General Plant Manager, January, 1926; Assistant to General Manager, Pacific Telephone and Telegraph Company, Oregon-Washington-Idaho Area, January, 1929.

BELL TELEPHONE LABORATORIES, INC.

H. P. Charlesworth elected Vice-President.

Entered employ of the Bell System engaging in circuit development engineering, American Telephone and Telegraph Company, Boston, 1905; Toll Traffic Engineering, New York City, 1907; Engineer, 1909; Plant Engineer, April, 1920; Vice-President, Bell Telephone Laboratories, Inc., December 24, 1928.

BELL TELEPHONE SECURITIES COMPANY

Clinton S. Van Cise elected Vice-President.

Entered employ of the Bell System as Bookkeeper, New York Telephone Company, New York City, July, 1914; Clerk, April, 1916; Accountant, March, 1919; Supervising Accountant, April, 1919; Clerk, American Telephone and Telegraph Company, January, 1921; Methods, Financial Department, May, 1921; Assistant to Treasurer, January, 1923; Assistant Treasurer, March, 1923; Vice-President, Bell Telephone Securities Company, December, 1928.